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The Institute of Vitreous Enamellers

The Welsh Engineers' and Founders' Association

and

The Foundry Trades' Equipment and Supplies Association

Institute of British Foundrymen

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Travel and Education

After a visit to the United States a few years ago, Dr. W. H. Hatfield, F.R.S., was generous in his praise of the equipment and staffing of the universities he inspected, and he was of opinion that money could be usefully spent on modernising and re-equipping United Kingdom laboratories. With all this we are in agreement, but paramount in any consideration of the subject is the question of distance. America is a large continent, and the American educational authorities have to cater for a wide area. Now in this country, with its small area, denseness of population and, in general, excellent transport facilities, conditions are such that better courses could be made available if each educational body would not attempt to do too much. At the moment, one large technical school is envisaging a large-scale rebuilding plan, and though it is less than 50 miles from two great metallurgical centres, it proposes establishing a metallurgical department. We agree that the development of the school is such that a proportion of its students require a knowledge of metallurgy, yet we cannot help but think that arrangements could be made with the universities of the other two cities to provide a suitable course of instruction, and, moreover, to do this at less cost than the creation of a new department. If the salaries of the staff of this department be placed at the low figure of £750 a year, this would pay for the travelling expenses of half-a-dozen students, and still leave a surplus as a grant to the organisation providing the facilities. The snag is often that, whilst money can be raised for housing, equipping and staffing a new department, no funds are available for paying transport fees for students. We are coming more and more to the conclusion that the time is ripe for the appointment of a Royal Commission to study and report upon facilities for specialised training with a view to eliminating departmental redundancy and to effect concentration of effort in a limited number of establishments. By the rationalisation of educational efforts, it is reasonable to expect (1) real saving to the national exchequer; (2) attraction to a centre or centres as principals, professors or lecturers of the best brains money can buy; (3) teaching, research and experimental equipment of the highest order; and (4) certification of the widest recognition. We are aware that there are as many "vested interests" in matters educational as in other walks of life, and only a body with the status of a Royal Commission would be in a position to state a case capable of receiving Parliamentary approbation.

A Metallurgical Qualification—I

There is no doubt that the responsibility of controlling the technical side of a modern plant, whether it be exercised by a man who regards himself primarily as an engineer, a chemist, or a metallurgist, is rapidly assuming a professional status. By that we imply its exercise by men of very definite training and experience and of integrity. Such characteristics call for embodiment in a definite professional qualification. How far do present possibilities meet present requirements? There are two aspects to consider; the foundry industry in particular, and the metal industry in general. The latter has to be brought in because there are many chemists and even metallurgists employed in foundries who have no direct practical foundry experience and who would consider their work in relation to metallurgical production as a whole rather than consider it exclusively in relation to founding. Founding, on the whole, is now well provided for. The man who is in a position to take a university degree is not worried about a professional qualification, for which the degree serves very well. The craftsman in founding or patternmaking can acquire the certificates of the City and Guilds of London Institute. The technical man can go for the national certificate in mechanical engineering with a foundry endorsement. The diploma of the British Foundry School is also open to those who can arrange for their employers to provide the necessary facilities. The general metallurgical industry is less well provided for. The young chemist, engineer or metallurgist can find no single qualification for which definite courses are available in the metallurgical field. Much has been written about the stranglehold of examinations on education, but an examination does provide an objective and, what is more important, it tends to create the centres and classes in the technical colleges through which the necessary instruction can be obtained. Failing this, the education of these young men has to be modified or adapted to suit the regulations of one of three or four institutions offering diplomas all concerned to some extent with metallurgy, but none wholly and completely with it. There is nothing corresponding to a national certificate in metallurgy as there is in chemistry, various branches of engineering, and other subjects.

Joint Committee on Materials and their Testing

A Committee having the above title has now been set up by a number of technical institutions and societies in Great Britain to act as the British national organisation in matters relating to materials and their testing.

The need in this country of some means to provide for more adequate co-ordination of the study of materials and their testing has, during the past year, received the earnest consideration of the principal technical institutions and societies who are concerned directly and indirectly with these important subjects. From the outset, the undesirability of creating yet another independent organisation was fully recognised and accepted, and attention has been devoted to the formation of a co-operative organisation set up within the existing framework of interested institutions and societies. The proposal was fully discussed at special conferences of nominated representatives of the councils of no less than thirty-five technical institutions. It was unanimously agreed that closer collaboration in this matter was indeed desirable, and a detailed scheme was evolved which has now resulted in the formation of the Joint Committee consisting of one nominated representative of each co-operating institution and society.

Materials are inseparably associated with engineering and industrial developments of all kinds, and there are few of the major technical institutions in this country whose activities do not include some attention to materials and testing. With the majority, however, this attention is necessarily limited in view of the much wider field of technical and professional interests of their members. Hence the need for some common co-operative platform now provided by the new Joint Committee upon which are represented no fewer than twenty-two institutions and societies. It is expressly understood that this new body shall not absorb or replace in any way the activities of any existing technical organisation; its essential object is to supplement with regard to materials and their testing the present activities of the co-operating organisation to an extent and in a manner as shall be agreed. These organisations have therefore agreed that the terms of reference of the Joint Committee shall be to act as the British national organisation in matters relating to materials and their testing with the following objects, namely:—

(1) To promote joint discussions on the wider aspects of these subjects falling within the terms of reference.

(2) To assist a co-operating institution or society in the presentation of a Paper or group of Papers dealing with a more detailed aspect of one of the subjects falling within the terms of reference.

(3) To undertake those duties with respect to international matters which properly devolve on the Joint Committee in accordance with its terms of reference.

Essentially, the work of the Joint Committee will divide into two fields of activity—national and international, of which the former will no doubt be of major importance. As a commencement in this field, the Committee is now engaged in making arrangements for a general discussion on the subject of the notched-bar test to be held in Manchester in the early autumn of the present year. The activities of the International Association for Testing Materials in this country are at present entrusted to the keeping of a British committee, and the latter has agreed that, at the conclusion of the London Congress of the International Association for Testing Materials now being held, the Joint Committee shall take over the representation in this country of all matters connected with the International Association.

Any member of the institutions or societies represented on the Joint Committee will be entitled to attend, without fee, the meetings, discussions, etc., organised by that Committee. No other form of membership is involved.

The following is a list of the co-operating institutions and societies who have already given official support to the scheme; in their opinion, the work of the Joint Committee is important, not only from the scientific and technical standpoint, but also from that of industry and of British prestige in international trade, and they trust the work of the Joint Committee will receive due recognition, interest and general support:—

British Association of Refrigeration; Incorporated Association of Architects and Surveyors; Institute of British Foundrymen; Institute of Fuel; Institute of Marine Engineers; Institute of Metals; Institute of Welding; Institution of Automobile Engineers; Institution of Civil Engineers; Institution of Electrical Engineers; Institution of Gas Engineers; Institution of Mechanical Engineers; Institution of Municipal and County Engineers; Institution of Naval Architects; Institution of Structural Engineers; Iron and Steel Institute; Junior Institution of Engineers; Manchester Association of Engineers; North East Coast Institution of Engineers and Shipbuilders; Society of Chemical Industry: Chemical Engineering Group; South Wales Institute of Engineers; Textile Institute.

The first chairman is Dr. H. J. Gough, F.R.S., largely through whose initiative the Joint Committee has come into being; the secretary is Mr. C. W. J. Taffs, M.Sc.(Eng.), of the staff of the Institution of Mechanical Engineers, the council of which have kindly offered the necessary facilities for office work at Storey's Gate, St. James's Park, London, S.W.1.

Association Technique de Fonderie

ELECTION OF OFFICERS

At the annual general meeting of the Association Technique de Fonderie, the following were elected to office for the session 1937-38:—

President: Mr. Achille Brizon, managing director of Fonderies A. Brizon, Courbevoie (Seine).

Senior Vice-President: Mr. Henri Sandré, chairman of the Société Métallurgique du Périgord.

Vice-Presidents: Professor Pierre Chevenard, technical director of Commentry, Fourchambault et Decazeville; Mr. Eugène Dady, President of the Foundry Friendly Society; Mr. Jean Derdinger, President emeritus of the French Non-ferrous Foundry Employers' Federation; Mr. Charles Koehler, chairman of the Fonderies de Saint-Ouen and general secretary of the French Foundry Owners' Federation; Mr. Jean Lobstein, managing director of the Lobstein Foundry Company and President of Paris Ironfounders Employers' Federation; Mr. Léon Montupet, managing director of the Montupet Foundry Company; Mr. Henri Strube, President of the French Non-ferrous Foundry Employers' Federation.

The foreign Vice-Presidents are Mr. J. Léonard (Belgium), Mr. J. M. Espana (Spain), Signor Frederico Jarach (Italy), and Mr. Léon Brasseur (Luxembourg).

General Secretary: Mr. Roger R. Meyer, director of the Société de Produits Métallurgiques.

Treasurer: Mr. Daniel Waeles, brassfounder.

THE PARSONS OIL ENGINE COMPANY, LIMITED, Southampton, announce a change of name to the Parsons Engineering Company, Limited.

Random Shots

It is a pity for those taking part in the Congress of the International Association for Testing Materials in London this week, that Summer time came into operation last Sunday. They begin by having already lost an hour of sleep, a commodity very precious to congressists the world over. What these poor people, upon whom rests the burden of finding the right material for the right purpose, will feel like by the end of the week, one dare not imagine. It certainly looks as if the whole of the programme has been designed specially to test the stuff such men are made of, for all conferences are alike in this matter of rising early in the morning and retiring late at night. One wonders how they do it. Maybe they are fortified by a continuous flow of non-Newtonian liquids, or perhaps they benefit by a complete understanding of the phenomena of creep recovery, which asserts itself at about 2 a.m. when they creep to bed to find themselves completely recovered by 8 a.m.

* * *

Monday night's soirée at Burlington House certainly demonstrated the excellent attendance at this conference. About 1,000 members and ladies jostled together in the reception rooms of the Royal Society, which, although they could hardly Brag of being of adequate size, yet were seen to be full of interesting things, when the crowd moved in one solid block to the refreshment room.

* * *

A little story is told of the beginnings of the Royal Society which is delightful in its simplicity. In the dim and distant time of the 17th century, a few scientists used to meet in an inn to discuss their problems. They argued for five consecutive nights as to whether or not a bowl of water, already full, would overflow if some goldfish were put in. At last one suggested that they might try it, and surprisingly they found out at once that it did overflow. Mr. Baldwin, was right, after all, when he asserted that nervous strain was necessarily a product of modern developments in the scientific and industrial world of to-day!

* * *

It is a relief to learn, after all, that the extra member of the party to Belgium last month was only a dear little dog. It definitely was black, and it definitely was a young lady, but quite definitely came from Scotland and not from the Belgian Congo. One cannot help but admire the braveness of Mr. Paul Fassotte, who having already a large family of daughters at home, so cheerfully takes in another young lady! In his wisdom he has chosen one that cannot chatter, but only bark!

* * *

This week's prize for patience goes to the Glasgow man who put three-and-a-half feet of injured snake in splints. A busy section of a Dalmarnock steelworks was seriously disorganised the other day when a snake crawled from a crate of scrap iron just arrived from Texas. Two men opening the case downed tools in a hurry; other workmen in the unloading shed did not wait to confirm the rumour. Glasgow's ace trapper, Mr. William Wilson, was called to the rescue and went big-game hunting in his car. He found the workmen gathered at a safe distance from the shed. Mr. Wilson lifted the snake with his bare hands and put it in a box. Later he identified it. It has a name nearly as long as this column and is as poisonous as it sounds. It appears that the visitor had a stormy passage from Texas. Its back was injured, and Mr. Wilson spent two ticklish hours fixing it up with splints.

"MARKSMAN."

Annual Branch Meetings of the Institute of British Foundrymen

LANCASHIRE BRANCH

The annual general meeting of the Lancashire Branch of the Institute of British Foundrymen was held at the Engineers' Club, Manchester, on April 3, when the Branch-President, Mr. J. Hogg, Burnley, was in the chair.

Proposing the adoption of the financial statement, MR. H. V. GRUNDY said he was impressed with the satisfactory financial position of the Branch. The total expenditure had been £154 2s. 11d., whilst the sum of £447 6s. had been paid into the central account. They had thus kept expenditure within one-third of the sum allotted to the General Council.

MR. E. FLOWER seconded the adoption, and said that the auditors were compelled to acknowledge that they had never known books kept so well as they were by the Branch-Secretary. Both MR. A. HOPWOOD and MR. W. HOLLAND, as auditors, substantiated Mr. Flower's statement.

The accounts were then put to the meeting and approved.

The Secretary's Report

The honorary secretary, MR. J. E. COOKE, in his report, said the Board of Development, acting as an advisory committee to the General Council of the Institute, had formulated schemes which had created a large amount of discussion, and two reports from that body had been submitted to Branch Councils. The Branch Council had carefully considered all the implications arising therefrom, and if their conclusions had not always been popular with the General Council, they had been honestly given and courageously upheld. The ferment of new ideas had not reached the point when the "brew" could be tapped for general approval—in due course that opportunity would be forthcoming—but this commendable judgment had been exhibited by Lancashire Branch members throughout all stages of the discussion.

The labours of three sub-committees of the Branch Council were worthy of special mention. One, dealing with the encouragement of technical education, had successfully organised new classes at Oldham, had increased attendance threefold at Openshaw, and had developed interest in Warrington which should come to fruition during the next session. The second sub-committee reorganised the method of conducting the "John Wilkinson" Medal Examination, and produced a useful basis for future competition. The Syllabus Publication Sub-Committee organised the lecture list and produced the syllabus handbook, and its success could be gauged from the fact that the lectures had been of considerable practical value and had continued to attract large attendances.

The works visits had been very successful. A party of 76 members visited the Ford Company's works at Dagenham, and 46 members took advantage of the opportunity to visit the Staveley Coal & Iron Company's works upon a weekday. Grateful acknowledgment was made to the firms mentioned in affording the facilities and hospitality.

The annual picnic to Grindleford was moderately well attended, 35 people being present, but the October social attracted 126 members and friends, and the attendance at the annual dinner was 170.

Membership of the Branch showed a further slight decline, 374 as against 383 last year, and subscriptions had fallen from £469 1s. 6d. to £447 6s. This decline should be arrested for the Preston Section had probably reached its basic level, and it was hoped that re-building would commence. The Burnley Section had retained a thriving and enthusiastic body of members who contributed very considerably to the success of the parent Branch. The Junior Section had continued, its social functions had been very successful, but attendance at meetings was not satisfactory. Thirteen competitors entered for the "John Wilkinson" Medal, but only three for the Short Paper competition.

The "Oliver Stubbs" Medal had been awarded to Mr. E. Longden during the year, and the Diploma of the Institute had been secured by Mr. A. Phillips. Both gentlemen were members of the Lancashire Branch.

The passing of two members—Mr. C. W. Kent and Mr. J. Haigh—who served the Branch in earlier days was recorded with much regret.

The upward trend of trade throughout the year had been exceptionally pleasing. The Branch Council felt that the membership which had been maintained so well during years of depression should leap forward to a much higher level. The co-operation of every member was desired in an attempt to increase both membership and influence.

In conclusion the secretary acknowledged with much gratitude the loyalty and support which he continuously received from the Branch-President, the Branch Council, the officers of the Sections, the secretary of the Institute and his staff, and from the members generally.

On the proposal of the CHAIRMAN, seconded by MR. W. N. COOK, the secretary's report was adopted.

MR. J. JACKSON, proposing a vote of thanks to the retiring Branch-President and officers, said the Branch was losing the guidance of a President who had been outstanding in the annals of the Branch. Mr. Hogg had been a very active member of the Institute from the formation of the Lancashire Branch, and had served on the General Council for 21 years. Such an unbroken record showed a wholehearted devotion to the interests of the Branch.

MR. J. PELL seconded the vote of thanks and endorsed Mr. Jackson's remarks. He had, he said, been a member of the Institute for 27 years, and could recall many Presidents and many retiring officers, but he did not think in all his experience that the Branch had been better served by the officers than at the present time.

The resolution having been carried, the CHAIRMAN responded. He sincerely thanked them for their kindness in carrying that vote of thanks in so hearty a manner. Although a President's duties were now very onerous—and he had known something about them in times gone by—he had not realised that they had increased to such an extent. He had been fortunate, as had the other Presidents, in having available the invaluable services of Mr. Cooke.

As Mr. Cooke had again kindly consented to be nominated for re-election as secretary, he knew that Mr. R. A. Jones, the new Branch-President, would have the same valuable assistance as he himself had had during the past twelve months. They would all regret that Mr. Jones was not present, because of serious illness, and they hoped he would soon be better. They were also sorry to learn that Mr. H. Stead, the assistant secretary, was at present undergoing treatment in a nursing home, and their good wishes for his recovery were extended to him.

Election of President

MR. HOGG then moved that the recommendation of the Branch Council be endorsed, and that Mr. R. A. Jones be elected Branch-President. He hoped that Mr. Jones' health would permit him to have a good year of office, and from what he had heard already of Mr. Jones' proposals, he felt sure they would be very happy under his guidance during the next twelve months.

MR. A. PHILLIPS seconded, and the motion was carried unanimously.

The HON. SECRETARY said it was customary for the President to respond on his election, but, unfortunately, Mr. Jones had been taken suddenly ill. He had, however, sent them a message in which he thanked the members for the honour bestowed upon him. He realised that the support and encouragement of the Council and all the members of the Branch must be the background of any success he might have as President, but he was also prepared to make unsparing personal effort in advancing the fortunes of the Institute and the Branch.

It was customary for the President-elect to announce advance details of the proposed summer programme, Whitsuntide and the Coronation being so close to each other, he proposed to arrange the annual picnic on the second Saturday in July, the destination of the outing to be Knaresborough. It was also hoped that an evening visit to the Electrical Chloride Company's works would be arranged.

He was also authorised to announce that an anonymous donor wished the Lancashire Branch to have the opportunity in Coronation Year of making a special contribution toward the advancement of the foundry industry. The Branch Council would shortly be asked to appoint a small committee to supervise arrangements for a competition, open to the whole of the British Isles. Two prizes of £12 each would be offered, one for the best original Paper upon modern practical non-ferrous foundry practice, and one for the best original Paper upon modern practical ferrous foundry practice. Two further prizes of £2 each would be offered for the Papers adjudged to be second best in each section. An independent jury would be empanelled and the Papers must be received by July 31. The judges' awards would be communicated by September 30.

Finally, Mr. Jones had expressed his wish that the members of the Branch should use the voting powers they possessed to the fullest possible extent when the whole membership of the Institute was asked to vote upon any question which might arise.

Vice-Presidents

MR. H. V. GRUNDY and MR. A. L. KEY were elected Senior and Junior Vice-Presidents respectively.

The CHAIRMAN said that a letter had been received from Mr. T. Makemson that he had heard a rumour to the effect that he (Mr. Makemson) had been nominated as candidate for the office of Junior Vice-President of the Branch. Naturally, he appreciated that honour, and he was very grateful for their kindness, but he felt that circumstances would not permit him to accept nomination.

Other Officers

The election for other officers of the Branch resulted as follows:—

Representatives to the Branch Council for three years.—Mr. A. Hopwood, Mr. E. J. L. Howard and Mr. J. Taylor.

Representatives to the Technical Committee for one year.—Mr. J. Jackson and Mr. A. Phillips.

Representatives to the General Council for one year.—Mr. W. N. Cook, Mr. J. Jackson, Mr. A. L. Key and Mr. A. Phillips.

Auditors—Mr. A. Hopwood and Mr. R. R. Hargraves.

Honorary Secretary.—Mr. J. E. Cooke.

Assistant Honorary Secretary.—Mr. H. Stead.

LONDON BRANCH

The annual meeting of the London Branch of the Institute was held at the Charing Cross Hotel, London, W.C.2, on April 7, with the Branch-President (Mr. V. Delport) in the chair.

The minutes of the preceding annual general meeting were taken as read, and were confirmed and signed.

Secretary's Report

Mr. H. W. Lockwood (Branch hon. secretary) presented his report on the 1936-37 session, in which he said it was with much pleasure that he was able to report on one of the most successful sessions in the history of the Branch. The membership figure to-day was 308, compared with 251 a year ago. This was the third successive new record the Branch had achieved, the figures being:—1934, 229; 1935, 251; and 1936, 308. The Branch income had shown a decided increase and last year's income had constituted a record. The programme of meetings was the largest and most varied which had been arranged, and, taking into consideration the programme of the East Anglian Section, no less than 21 different meetings and events were arranged. Following the policy of fostering closer relationship with other Branches of the Institute, the members had entertained the Birmingham Branch at a joint conference in October last. The annual dinner in December had been very well attended and the Branch was successful in making contact with the Worshipful Company of Founders by entertaining their Master, Mr. W. Christopher, as its principal guest. It also entertained in December members of the London Section of the Institute of Metals at a joint meeting in London. It had been decided on this occasion to depart from the usual Paper on metallurgy or foundry practice, and Mr. W. T. Griffiths had been invited to speak about his impressions of industry in Russia. The experiment had proved a complete success, 140 members of both Institutes being present; a long discussion ensued, and the meeting continued until midnight. Another interesting event had been a visit to Belgian foundries, which took place last month. Twenty-one members had taken part and six foundries were visited. Mr. Leonard, immediate Past-President of the International Committee of Foundry Technical Associations, received the party at Antwerp, and the Belgian Foundry Technical Association had kindly entertained the membbers during the visit.

East Anglian Section

The outstanding event of the session had been the inauguration of the East Anglian Section, under the presidency of Mr. L. J. Tibbenham. This Section, which worked under the auspices of the London Branch, had held its first regular meeting in October of last year, and since then five ordinary meetings, two works visits, and the first annual dinner had been held.

The membership of the Section had increased from 24 to 48, and at one of their meetings in Colchester over 100 people had been present. There was every reason to suppose that this Section would continue to expand, and he paid a tribute to the excellent work which had been done by the hon. Section secretary, Mr. J. L. Francis.

The past year had undoubtedly been the most notable in the Branch's history, and Mr. Lockwood concluded by expressing to the Branch-President and to the Council and members his warm thanks for the kindly consideration and help always extended to him, especially during this rather strenuous session.

The Branch-President expressed pleasure that, for the third year in succession, the Branch had made good progress from the points of view of membership, finance and the interest of its programme. During the session attendances at the Branch meetings had improved, although, having regard to the Branch membership of more than 300, the average attendance was not quite so large as perhaps it should be. At one of the meetings of the East Anglian Section, as many as 100 people had attended, a fact which was worth noting.

On the motion of Mr. F. Gentles, seconded by Mr. H. S. Rooke, the hon. secretary's report was adopted, without discussion.

Branch Officers and Council

Branch-President. — The Branch-President proposed that Dr. A. B. Everest (Senior Vice-President) be elected Branch-President for the coming year, and expressed the confidence which he knew the Branch members would share in Dr. Everest's efficiency in that office. Dr. Everest, he said, had a very close connection with the foundry industry, an expert knowledge of cast iron and a wide experience of technical meetings, and the Branch could not choose a better President. The resolution was seconded by Mr. W. E. Benbow and was carried.

Dr. A. B. Everest, in a brief expression of thanks for the confidence reposed in him, said that, in view of the records established during the past year he had a high standard to live up to. This was an added stimulation to him to do his best.

Senior Vice-President.—Dr. Everest proposed the election of Mr. C. C. Booth (who had served as Junior Vice-President) to the office of Senior Vice-President. He assured Mr. Booth of the continued confidence the members had in him, and said they looked forward to his occupation of the Branch Presidential Chair eventually. The resolution was seconded by Mr. B. B. Kent and carried unanimously. Mr. Booth briefly responded.

Junior Vice-President.—Mr. Booth proposed the election of Mr. Barrington Hooper, C.B.E., as Junior Vice-President, and referred to him as a very able man who had rendered great assistance to the Branch in the past and would continue to do so in the future. The resolution was seconded by Mr. F. J. Wares and was carried with acclamation.

Mr. Barrington Hooper, responding, said that although he was not a practical man so far as foundry work was concerned, he would have the assistance of practical foundrymen and hoped to pull his weight in various other directions.

Branch Honorary Secretary.—The Branch-President announced that Mr. H. W. Lockwood, who had served the Branch so well as honorary secretary during the past few years, had decided with regret, to offer his resignation from that office. It would be appreciated that Mr. Lockwood's time was becoming more and more occupied, and the duties of honorary secretary of a Branch of the Institute, particularly one such as the London Branch, were very onerous, calling for the devotion of a great deal of time and thought by one so interested and enthusiastic as Mr. Lockwood. He regretted that he had found it necessary to resign, but it would be appreciated that a man holding a responsible position in business could not carry on honorary work indefinitely when so much of his time had to be devoted to it. The members of the Branch could only accept his resignation, and on their behalf the Branch-President expressed very great appreciation of all he had done during the five or six years during which he had been in office. The vote of thanks was carried.

Mr. H. W. Lockwood, responding, said he had found his resignation from office to be necessary by reason of the time he had to devote to his ordinary business affairs. He considered it a good thing to encourage the young men in the Branch to take office. He took the opportunity to express his personal thanks to Mr. V. C. Faulkner, who was one of the hardest workers in the London Branch and was always ready to give the best of advice. Indeed, all the officers of the Branch turned to him for advice, and Mr. Lockwood welcomed the opportunity to pay tribute to him publicly. He personally regretted having to relinquish the post of hon. secretary, but he proposed the election of Mr. R. Causebrooke as his successor. Unfortunately, Mr. Causebrooke was unable to attend the meeting, owing to illness; but he was a man who would take the work seriously, and the directors of his firm had promised to give him every facility and adequate time to carry on the duties of the office.

The resolution was seconded by Mr. F. A. Wilson, and the meeting unanimously elected Mr. Causebrooke.

Members of Branch Council.—In view of Mr. Barrington Hooper's elevation to the Vice-Presidency, there was a vacancy on the Council, and, on the motion of the Branch-President, seconded by Dr. Everest, the meeting unanimously elected Mr. H. W. Lockwood to the Council. On the motion of Mr. F. Gentles, seconded by Mr. V. C. Faulkner, the meeting unanimously re-elected to the Council Mr. B. B. Kent, Mr. F. J. Wares and Mr. R. Templeton, who had retired by rotation.

Honorary Auditors.—On the motion of the Branch-President, seconded by Mr. D. A. Williams, the meeting re-elected Mr. A. R. Bartlett and Mr. C. Cleaver as honorary auditors.

Delegates to General Council.—The three delegates to the General Council were Mr. C. H. Kain, Dr. A. B. Everest and Mr. B. B. Kent. Dr. Everest, however, by reason of his election as Branch-President, became an *ex-officio* member of General Council, and it was recommended that the vacancy be filled by Mr. Lockwood. On the motion of Mr. Cleaver, seconded by Mr. Faulkner, therefore, Mr. C. H. Kain, Mr. B. B. Kent and Mr. H. W. Lockwood were elected delegates to General Council.

Representatives on Technical Committee.—Mr. A. J. Murphy and Mr. A. Logan were elected representatives of the Branch on the Institute's Technical Committee.

Vote of Thanks to Branch-President

Mr. C. H. Kain proposed a hearty vote of thanks to Mr. Delport for his able guidance of the Branch, as its President, throughout the past year. The fact that the Branch had established records during the year, he said, was a feather in Mr. Delport's cap. The vote of thanks was carried.

Mr. Delport, responding, assured the members that his year of office had been most interesting and had enriched his experience. It had been a privilege and an honour to serve as Branch-President. He would not wish for a moment to take all the credit for the fact that the Branch had established records during the year. He expressed thanks to his fellow officers and members of the Branch Council, and members of the Branch generally, for their sympathetic help; and on their behalf and his own he thanked Mr. Lockwood particularly for his efficient work as hon. secretary over a number of years. Finally, he wished his successor, Dr. Everest, as much pleasure in the office of Branch-President as he himself had derived from it.

SHEFFIELD BRANCH

The annual meeting of the Sheffield Branch was held at the King's Head Hotel, Sheffield, on April 1.

Mr. J. Roxburgh, the retiring President, who occupied the chair, proposed that Mr. J. B. Allan be elected Branch-President. He remarked that Mr. Allan had been a member of the Institute for eight years, and had associated himself very keenly with its activities. He was sure that they would have the greatest confidence in Mr. Allan's ability as their President. Mr. R. C. Tucker, seconding, said Mr. Allan had been one of the best members which the

(*Concluded on page* 328.)

Cupola Practice*

By W. SPIERS

Any useful information which the author has personally obtained in nearly thirty years' practice has had McLain's lessons as a foundation, and actually this Paper was to have been written by McLain, but unfortunately he was unable to fulfil his promise owing to illness, and therefore the present author has deputised.

A cupola is used for the purpose of melting pig-iron and scrap to produce clean mixtures of molten iron sufficiently hot enough to pour into suitable moulds, and to make a large variety of mixtures within reasonable limits of analysis. Purchased scrap is not necessary, and a number of foundries are melting only pig-iron and their own returns. It should be noted that the ironfounder making rain-water goods or saucepans, uses the same equipment to produce his iron as the ironfounder who manufactures high pressure-resisting iron, or high-class machine tools, Diesel engine, heat- or abrasion-resisting irons, and that while no one is expected to melt all these irons in one day, the variation called for in some foundries is tremendous. In a single day the author has melted iron to make castings less than ¼ in. in thickness that must be capable of being machined at very high speeds, and which must be clean and sound, and also iron with an 80 per cent. steel content to make castings 3 in. in thickness for heat-resisting purposes.

The question of receivers, or drop or solid bottoms, while worthy of consideration, will not be fully considered in this Paper. One should agree, if possible on the best method of economically melting clean iron as nearly as possibly to the analysis required,

In theory a cupola working efficiently and capable of melting 12 tons per hr., should give every minute 4 cwts. of iron which can be kept as hot as necessary in a tapping-out ladle. The dimensions of a cupola necessary to melt the required amount of iron are well-known, and a number of reputable firms are marketing cupolas which very closely approximate to the details given by McLain, after he had made tests on many thousands of cupolas in all parts of the world.

Lighting Up

Before operating a cupola, a fire is usually started with wood and gas coke in sufficient quantity to get the foundry coke sufficiently hot to burn, and the initial fire should be well ignited for two hours before the blast is put on. Sufficient free air must be available to keep the first fire alight and all cupolas should be high enough to carry a natural draft. The cupola should be loaded with foundry coke well above the tuyeres after this time and the necessary coke to make bed height should be added, along with the first charge of metal, just before the blast is put on. After the blast is put on, if the cupola is properly designed and air supply correct, melting will commence in 7½ min. If the iron starts to melt before this time, the bed is too low, and if it takes longer to melt, the bed is too high. Even under good conditions, the first few hundredweights of iron melted are not up to the standard of later taps, and suitable moulds are usually prepared to receive this. Reference is made to a foundry which produces no castings over 5 to 6 cwts., and the bulk of the work must be capable of being machined all over at very high speeds, and must be of sufficiently high quality to make cut gear wheels, etc.

Charge Separation

A foundry engaged on fairly large work would be able to use a sufficiently large quantity of iron for the first cast to absorb the first melt. Usual runs of standard iron made from pig and cast scrap can be utilised to suit foundry requirements, *i.e.*, if the charge is 10 cwts. and there is available a 5-cwt. shank, there is no harm in using this, but, where a special charge is put on, containing a quantity of steel, or alloys, one method must be adopted and not departed from.

The foundry foreman, or the man tapping out, must know when the special charge is due, and see that the previous one is clear. A personal method is to aim at a certain weight on each special charge, where possible, or half this weight if the full charge is not called for. A special shank is put into use, and if operations are successful, the tap clears the charge, and either fills or half-fills the shank. The charge is not used until the required amount is tapped out. It has been found, over a great number of years, that if reasonable care be taken the charge is obtained when and where it is expected. An unusual precaution is taken of adding 25 per cent. extra to the coke split before each special charge. This coke is not wasted, as the iron is hotter, and no other method of keeping the bed height correct is necessary, even over a long blow.

Cupola Production

Purposely no dimensions have been given, nor percentages of coke to iron mentioned, but if the cupola is working efficiently the minimum output should be 10 lbs. of iron per sq. in. of cupola area, per hr.; 12 lbs. are possible, but 10 lbs. should be the minimum. Tuyeres are better if fitted with a slide to enable the blast to be cut off should slag or iron settle in front of the tuyeres.

Volume of Air Necessary

If air be delivered in the correct quantity, *i.e.*, 33,000 cu. ft. per ton of iron to be melted, there is no need to worry about blast pressure. The metal itself will quickly indicate if there is too much air, because while the furnace is apparently melting very hot iron, the metal will "go off" very quickly in the shank, even if the phosphorus is normal. If there is insufficient air, the iron will be dull and stiff. Care should be taken where cupolas are hand fed to have the coke and metal charged as evenly as possible. If all the coke is put on one side of the cupola and the metal on the other, it will result in two charges becoming mixed and not being separated by the necessary split of coke.

Design and Quality

Not many years ago, Mr. Horace Young definitely stated that, given steel scrap, hematite, and any local brand of pig, he would produce any metal specification required, and if the cupola be correctly designed, he is certainly correct.

Working to Schedule

In most foundries the management does not pay sufficient attention to the operation of the cupola, or to its operating staff. Any saving is profit, and by correctly operating the cupola, one can save both on coke and time, in addition to producing a larger percentage of good castings. If a start is made with a newly-lined cupola with good bricks and a minimum number of joints, no repairs will be required for several days. Whatever the initial size, the lining will be parallel, but after working it will gradually increase in diameter at the melting zone. It is advisable to keep the shape that develops after a few blows, and not attempt to regain the original shape. It may been found that one tuyere will be burnt back and the lining will be thinner around this than around the other three. In that case the lining is cut out, rebricked, and a new tuyere is fitted. As the others show signs of wear, they, too, are similarly dealt with, and total rebricking is delayed. Any patching which may become necessary should be put on as dry as possible, not too thick, and as early as is convenient to allow a natural drying.

All cupolas must be studied as separate units until the best method of operating is ascertained. Many things can cause a variation in the working of a cupola; the proximity of buildings, for instance, can cause a back draft that will give rise to considerable trouble, and in some cases can only be overcome by raising the stack. Tuyeres should be of ample size when the cupola is installed, and should incorporate an arrangement to allow their inlet to be reduced in area or closed. A blast gate should be fitted with some method of locking it in the correct position. A few days' blowing will give all the necessary information to get the cupola in first-class order.

The cupola in general use at the author's foundry is 26 in. dia., and a typical charge sheet will read as follows:—

First charge.—5 cwts.; no flux; 50 lbs. coke.

Second charge.—8 cwts.; 9 lbs. limestone, 50 lbs. coke.

All succeeding charges, except special, are 8 cwts., with 9 lbs. flux and 50 lbs. coke, with an extra 25 per cent. of coke for special mixtures.

Soda Ash

This compound, while giving clean iron and clean ladles, has been found by the author to be very severe on the furnace lining, and, as hand-charging is practised, the gas produced is objectionable to the man charging.

The Cupola Bottom

The cupola bottom should be made up with as much care as an open sand mould; wires should be rammed in and the bottom properly vented to allow the first iron melted to lay on without disturbance. The bottom should slope very slightly towards the tapping hole, which should be as short as possible. If iron is to be used as hot as possible, arrangements must be made to convey the metal to the moulds with as little loss of heat as possible. To ensure this, all shanks must be well vented and thoroughly dried.

The height of the coke bed, when found, should be recorded and checked from the charging door, and every time the cupola is ready for the first iron, but before the blast is put on, this height must be tested and corrected if necessary. Early lighting-up, thorough preheating and correct height of bed coke level are extremely important items, and if precise instructions are followed, the quality of the metal cast will repay the management for all the trouble, whilst the satisfaction of the moulders in knowing that the iron will not disappoint them is in itself worth working for.

Experimental Furnaces

There has been quite a number of experiments with melting furnaces, but as far as is personally known the standard cupola is still the most economical method of producing molten iron. The demand to-day is for alloy irons of varying composition, but there are few castings that cannot be satisfactorily made with a correctly operated cupola, and a reasonable knowledge of what is necessary to give the required results. The author makes this statement after despatching special heat and wear-resisting castings all over this country, as well as hydraulic castings that had to withstand a pressure test of 3,000 lbs. to the sq. in. The author is not prepared to discuss whether it is necessary to use some of the alloys called for. He is prepared, however, to give credit to the valuable work that

* A Paper read before the East Midlands Branch of the Institute of British Foundrymen, Mr. H. Bunting presiding.

has been carried out by special processes and by the use of the newer type of furnaces, but personal results, using a simple cupola for a very large range of casting specifications, have been very satisfactory.

The author's most usual casting is one which must be machinable at very high machining speeds. Castings which he has produced are now running at more than 300 ft. per minute in capstan and automatics, lathes, not only with "Wimet" tooling, but with the usual high-speed steel tooling. This metal also gives a reasonable tensile strength, and it must be good enough to make into cut gears.

Slagging Out

Slagging is not often necessary with the short blows practised, but if there is a charge very heavy in steel, a slag hole is placed just below the wind belt, and is opened when it is anticipated that about 50 per cent. of this charge is melted, and is closed when iron shows.

It has been found that no cold addition to the metal is beneficial, except probably a small amount of thin aluminium put into the ladle bottom before tapping into it.

Balanced-Blast Cupola

The Balanced-Blast cupola seems to have arrived as the result of great effort, and is in all cases personally examined, a very definite improvement upon the standards obtaining prior to its adoption. The highest temperature of the metal tapped out of an ordinary cupola is 1,350 deg. C., as against 1,450 deg. C. in the Balanced-Blast plant.

Part of this variation may be due to variation in the reading of the two different pyrometers used, but it has been found that when metal was 1,200 deg. C. and ready to pour, very light castings could be quite satisfactorily run. This then allows a reasonable margin in which metal may be tapped out, transferred from cupola ladle to travelling ladle and down the line of moulds, where casting will commence without loss of the heat necessary to produce a successful casting.

The cupola is re-lined about every two years, but as a large quantity of steel is used, it is thought that a foundry using no steel would find the lining lasting much longer. The whole lining is not knocked out. It is packed up from the charging hole door, and is filled in below.

Loose borings have been melted in the cupola, but this definitely slows the melt, as it is necessary to vary the blast when making such additions, and in the early melting stages.

As a proof that good melting, or good cupola practice, is a paying proposition, and to test how far one could go in case it was desired to make a cheap mixture, a charge of 25 per cent. malleable, 25 per cent. steel scrap and 50 per cent. of the roughest cast scrap available was melted, and a machinable-quality casting of reasonably light section was produced. The experiment was not pursued, owing to difficulty in keeping too many kinds of scrap separate. It is more important to keep spare iron, scrap, etc., and each special mixture separate, than it is to separate the brands of pig-iron.

Reference has only been made to a fan-blown cupola, suitable for grey iron. The same may hold good for malleable iron, but no personal experience of melting this metal has been had. The question of mechanical charging is a matter that only enters where much longer blows are in use than in the case under consideration. No comparison has been drawn between the ordinary and the Balanced-Blast cupola, as the information regarding this is very well known. Great efforts have been made to improve the cupola as a melting unit, and many attempts have been made to evolve a better melting medium than the cupola, and while giving credit for these both successful and unsuccessful attempts, it is thought that the cupola as designed by McLain, the details of which are well known, still holds the field for quality, speed and accuracy.

Powerful Hand Magnet

The hand magnet illustrated is a compact and powerful unit; as a matter of fact, it will actually lift a weight of 56 lbs., though the magnet itself weighs rather less than 5 lbs.

As it operates on a permanent magnet system, it is entirely self-contained, but can be turned "on" or "off" in an instant by operating the lever placed beneath the handle. It cannot lose its magnetism, so that the maximum efficiency is always maintained. In addition, with its special high-density gap attachment, it will detect even the smallest particles of magnetic material in fine powders or liquids.

The efficiency of magnetic separation has been brought to a very high standard, so that implicit reliance is usually placed upon it. At the same time, a periodic check should be made of their efficiency. This simple hand magnet offers a ready means of making such check without calling for any skill in its application. It would also prove of service in checking the value of mixed scrap (turnings, millings, etc.) by determining the ferrous content.

Permanent Hand Magnet.

In the works laboratory it should prove exceedingly useful for sorting small quantities of mixed scrap and for the elimination of magnetic materials from liquids, powders, etc.

The makers of the appliance are James Neill & Company (Sheffield), Limited, of Sheffield.

Catalogue Received

Drying Stoves. We have received from Robson Refractories Limited, Coniscliffe Road, Darlington, a four-page leaflet which illustrates and describes a series of mould and core drying stoves. The stoves are very highly thought of in Germany, and this type was chosen by their leading experts for inclusion in the technical exhibit of the Düsseldorf Foundry Exhibition last autumn as representative of the latest and best practice. The leaflet contains eleven illustrations of stoves and the loads they take and, included amongst them, are types with removable roofs, compartmentalised; bogie loaded; tray loaded; and shelved. All shown are of the batch type. One performance is quoted as drying 40 moulds of 2 ft. by 1 ft. 8 ft. by 7 in. in 4 hrs., including charging time. The coke consumption for two charges was just over 2½ cwts., whilst the power consumption of the fan was 1.2 h.p. Included with the leaflet, is a sheet giving particulars of the installations made by thirty firms. It should be pointed out that there is the same system operating in every case, so that certain existing furnaces can be modified to embrace it.

Annual Branch Meetings of the Institute of British Foundrymen

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Branch had ever had, and would make one of the best Presidents. The resolution was carried unanimously.

Mr. Allan, in reply, said he very much appreciated the honour, and he would do his very best for the Branch and for the Institute in general. He proposed the election of Professor J. H. Andrew, Dean of the Faculty of Metallurgy in the University of Sheffield, as Senior Vice-President. He referred to Professor Andrew's eminence in the metallurgical world, and said it was a great honour to be associated with him.

Mr. A. Whiteley seconded the resolution which was carried unanimously.

Mr. C. Leetch proposed that Mr. Malcolm Brown be elected as Junior Vice-President. Mr Brown was associated with steel founding, and it would be a good thing in the years to come, to have a President who was intimately associated with that branch of the industry. Mr. F. Whitehouse seconded the resolution, which was carried.

Mr. R. C. Tucker and Mr. T. C. Firth were re-elected members of the Branch Committee, on which they are already serving their third year, and Dr. C. J. Dadswell was elected to fill the vacancy caused by the elevation of Mr. Malcolm Brown.

Mr. C. D. Pollard and Mr. T. R. Walker were re-elected members of the Technical Council, and Mr. C. D. Pollard and Mr. J. Roxburgh were elected delegates to the Council.

Mr. G. L. Oxley and Mr. S. Leetch were re-appointed auditors.

Mr. J. B. Allan, proposing the re-election of Mr. T. R. Walker as honorary secretary and treasurer, said Mr. Walker had served the Branch in a splendid way for many years. Mr. J. Roxburgh, seconding, said he could speak from experience of the very able way in which Mr. Walker assisted the Branch-President. He carried out his duties splendidly. The resolution was carried.

Mr. T. R. Walker, in reply, said the welfare of the Sheffield Branch was a matter of great concern to him, and he should do his best to improve it.

A hearty vote of thanks was accorded to Mr. Roxburgh for his services as Branch-President during the past session, on the motion of Mr. C. Leetch, seconded by Mr. C. D. Pollard. Both speakers expressed the Branch's appreciation of the manner in which Mr. Roxburgh had conducted the business of the meetings, and Mr. Pollard added that they congratulated him on having been chosen as the author of the Institute's Exchange Paper that was to be given to the American Foundrymen's Association congress during this year.

Mr. Roxburgh, in reply, said he greatly appreciated the fact that it was felt he had done something to help on the work of the Institute. He had thoroughly enjoyed his experience as President. It had entailed a certain amount of work, but he had been more than recompensed by the enjoyment derived from it. He was sure his successor would have an equally pleasant experience. He wished Mr. Allan success in the office, which, he knew, he would fill with distinction.

Blast-Furnacemen's Wages

As a result of the increased ascertained selling price of West Coast hematite pig-iron, Bessemer mixed numbers, for the first three months of the year by 1s. 9.54d. per ton, Cumberland and North Lancashire blast-furnacemen receive another increase in wages of 2½ per cent. In all cases where the men are working the 48 hours week 10.66d. is added to the gross total of base earnings and scale percentage.

The Manufacture of Iron and Steel Castings in Green Sand*

By C. J. DADSWELL, T. R. WALKER, and F. WHITEHOUSE

The reason usually advanced for the manufacture of castings in green sand, instead of in dry sand, is that there is a saving in cost when green sand is adopted. This is generally true, but in certain instances there are other factors which influence the choice of method. In any case, any advantages green sand practice may possess are not obtained without careful study; special precautions must often be taken, and the process has inherent disadvantages which limit its application.

Advantages Shown

The first important advantage is that moulds need not be dried. This saves the cost of drying

Fig. 1.—A 5 ft. long Steel Casting Made in Green Sand.

equipment, and also the cost of drying, which includes not only fuel, but the time and wages of stove attendants. It also liberates the space otherwise required for drying equipment, and enables the space to be usefully employed for other purposes. There is an additional saving in the time normally occupied in the drying operation. In consequence the capacity of the foundry floor for moulding and for putting down boxes is increased, so that if the capacity of the melting unit is adequate, the output of the foundry may be increased. Alternatively, for a given output of castings, fewer moulding boxes are required, since they are returned to the moulding bay in a shorter time than when making dry sand castings. This is of particular importance in the quantity-production of castings, when moulding machines are being employed which should be kept fully occupied. In some cases green sand castings have a sharper outline than those made in dried moulds, that is to say, more detail is reproduced.

The fact that the mould material has comparatively little strength gives increased freedom from pulls or hot tears, and brackets can frequently be eliminated which are required when castings are made in dry sand. Owing to the reduced tendency to tear, less easing of the castings is required. These last remarks, of course, apply almost entirely to steel castings. Fig. 1 is an example of a thin steel casting about 5 ft. long successfully made in green sand without tears and with a good finish.

The cost of closing moulds is less than for similar jobs made in dry sand, as the cores can be fixed into their prints with less filing and fitting. This is because the green sand prints give way slightly and adjust themselves to any small irregularities in the cores. The fact that the cores fit closer into green sand prints means that less flash is produced, so that the cost of fettling is reduced. In addition, the way in which the green sand prints can be, to some extent, distorted, allows cores to be set up by gauges in the mould, producing greater accuracy in the subsequent castings. This distortion, however, may also lead to inaccuracies in the castings, since the fact that the prints are not rigid means that unless gauges are used it is very easy for cores to be misplaced. Fig. 2 shows an automatic railway coupler and its components. This is an example of the accuracy

Fig. 2.—Automatic Railway Coupler Cast in Green Sand and Assembled without Machining.

which can be obtained in green sand steel castings as all the working parts are assembled in the coupler body without machining.

Horseshoe nails and special chills can be inserted in the moulds at chosen points during

Fig. 3.—Defects and Swellings which may Occur on Green Sand Steel Castings.

closing without the mould surface being damaged. Finally, for some types of steel castings it is possible to use the same sand for both facing and backing purposes, which leads to a saving of time when machine moulding is being carried out.

Disadvantages

The first disadvantage of green sand moulding is that the weakness of the moulding material limits the size of the casting. Castings can be made in green sand only if they do not involve a high ferrostatic pressure or very heavy sections. The mould surface is weak and easily washed away in front of the runners unless precautions are taken to avoid this. Nailing can be adopted, or inserts of either dry sand or oil sand can be used, but these devices naturally increase the cost of the process. In addition, the weakness of the surface of the mould is liable to give rise to sand inclusions at, or underneath, the surface of the castings.

Green sand moulds naturally require more careful handling during closing than dry sand moulds do, and they are also more easily crushed. Green sand castings are more liable than dry sand castings to such defects as swellings, scabs and blowholes, owing partly to the weakness of the sand and partly to its water content. Swelling and scabbing may be minimised by hard ramming of the mould. Fig. 3 illustrates the defects

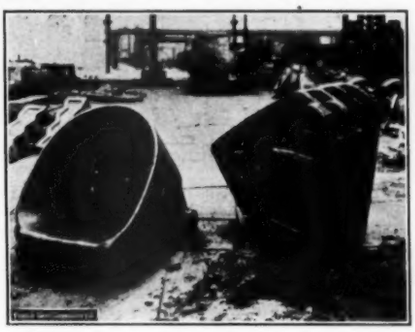

Fig. 4.—Dredger Bucket Cast in Green Sand. The Core is supported from the Box Bars.

of swelling and scabbing which are prone to occur in certain types of green sand steel castings.

If green sand moulds are not cast within a certain time, any nails or chills inserted in the moulds tend to condense on their surfaces a layer of moisture which causes small blowholes in the castings. Similarly, unless the core compound in use is of a type which will resist the action of water, the moisture in the mould will soften the oil-sand cores, if moulds are allowed to stand for too long after closing and before casting. In such circumstances, if it is not possible to cast closed moulds on the same day, so that they are left over until the next day, it is often possible to keep them in good condition by lifting the tops and packing them above the bottom parts with, say, pieces of brick.

Since green sand moulds are not so hard as dry sand moulds, the core prints are not always strong enough to prevent the lifting of cores during pouring. Chaplets cannot be used satisfactorily between the cores and the mould surfaces, since the chaplets would penetrate into the relatively soft mould surface instead of stopping the cores from lifting. This trouble may be eliminated in several ways, for example, by packing the prints from the box bars. Fig. 4 shows a steel dredger bucket cast in green sand and weighing about 15 cwts. In this case a heavy core was used which had to be supported in the green sand mould by packing from the box bars.

In green sand repetition work, accurately jigged boxes are required, and good fitting pins must be used. Metal "carrots," sand buttons and sockets are useless in this case, since they have no rigidity and will not register the top and bottom parts with any accuracy.

Sand Practice

For successful results in green sand moulding, it is necessary to devote some care to such

* A Paper read before the Sheffield Branch of the Institute of British Foundrymen, Mr. J. Roxburgh presiding. The authors are respectively, foundry manager, English Steel Corporation, Limited; chief research chemist, English Steel Corporation, Limited; and foundry manager, Newton, Chambers & Company, Limited.

modifications of ordinary dry sand moulding practice as are demanded by the different nature of the moulding material. Patterns for green sand work should have a very smooth surface, in order to obtain a good draw, since patching and rectifying the surface of the mould are more difficult and less satisfactory in green sand than in dry sand, particularly for steel, and often lead to the occurrence of scabs and other surface imperfections in the castings.

The moulding boxes must be rigid, particularly those used for moulding top parts; neglect of this precaution may lead to the dropping-out of the mould during lifting or transfer from one part of the floor to another. In the case of steel castings, especially those run from bottom-poured ladles, sufficient depth of the bottom part is necessary to prevent the steel bursting out at the bottom. For the same reason bottom parts must be well rammed, and if they are moulded on machines must be properly flat-rammed between the bars. During pouring, the boxes must be fitted on good level beds of dry sand, or other adequate means must be used to support the bottom box.

Gating Modifications

The provision of gates also requires consideration. Moulded gates are better than gates afterwards cut in green sand moulds, as they are stronger and have a stiffer surface. An alternative is the use of oil-sand cores in which the runners have been moulded.

A point of particular importance in green sand steel castings is the position of the runner, since the mould material is not able to withstand very much washing of the liquid steel over its surface. Often the normal practice of bottom running gives satisfactory results, but in many instances this is not so good as running at the joint, or even from the top of a casting. The adoption of bottom pouring for a deep casting means that a large amount of liquid steel has to be forced up the sides of the mould, whereas running at the joint means that some of the steel falls downwards and the rest is forced upwards. In some cases top pouring can be carried out successfully if the liquid steel is allowed to fall on a core in the bottom of the mould placed there for this precise purpose, or alternatively on one of the cores which is a normal component of the mould.

Down-gates for steel castings should be made of fireclay, since green sand will not withstand successfully the wash of the steel. For the same reason, runner bushes are commonly made in dry sand.

Green Sand Cores

An obvious extension of green sand moulding is the use of green sand cores instead of either dry sand or the much commoner oil sand cores. This is a matter in which steady progress is being made, this progress being more marked and more rapid in iron foundries than in steel foundries.

The first important advantage in the use of green sand cores is that the core mixtures are very much cheaper than mixtures of silica sand with core compound. Just as in the case of green sand moulding, the cost of drying equipment and of the drying operation is eliminated. This means, of course, that the capacity of the core shop is increased. An advantage in using green sand cores is that they diminish cracking and hot tears, since they give way readily to the forces of contraction owing to their low mechanical strength.

There are, however, distinct drawbacks to the use of green sand cores which offset the advantages referred to above. In the first place, the low mechanical strength of the core does not permit of much overhang, so that this at once limits the application of the method. In the case of small and medium-sized cores, only such cores can be used green as can be safely conveyed from the core table and placed in the mould without sagging. Green sand cores are more fragile than green sand moulds, in that green sand moulds have the support of their box, in the bottom part at any rate.

Generally speaking, green sand cores are less refractory than oil-sand cores, which on strong heating are reduced essentially to silica sand. This means that green sand cored castings often involve more sand blasting, which is more difficult to carry out in recesses than it is on the outside of the casting. It is possible to use larger green sand cores when floor or pit moulding is being carried out, since the cores can then be built up *in situ*, and do not have to be handled or conveyed to another part of the foundry.

Although in the manufacture of green sand castings in iron and steel there are many principles which are, in general, applicable to both materials, there are some points which affect the manufacture of castings in only one of them.

Properties of Steel in Relation to Green Sand

In the case of steel castings, the properties of the liquid steel are of importance in obtaining success in the foundry. Though no particular change in chemical composition need be made when changing from dry sand to green sand moulding, the method of steel manufacture sometimes needs modifications if success in making green sand castings is to be obtained. From a foundry point of view, steel should have a low content of dissolved gases. If its gas content is considerable, then gases will be evolved when the steel is cooling in the mould, and blowholes of some kind will result.

This point is of particular importance when green sand castings are being made, since steam is evolved from the mould when the steel is poured into green sand moulds, and the passage of such steam through the steel is liable to cause the evolution from the steel of dissolved other gases which, without being disturbed in this way, would not be evolved.

The other important property from a foundry point of view is the life of the steel. It should remain pourable over a considerable range of

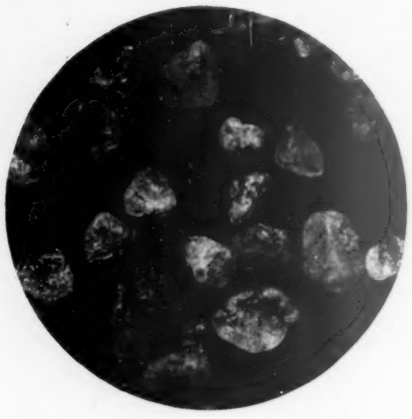

Fig. 5.—Round-Grained Silica Sand. × 25.

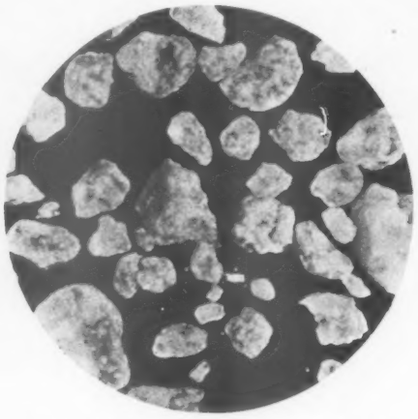

Fig. 6.—Naturally-bonded Angular-grained Sand. × 25.

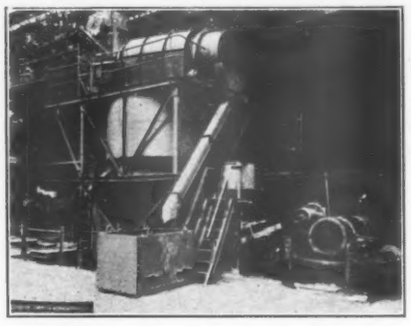

Fig. 7.—Sand Mixing Plant.

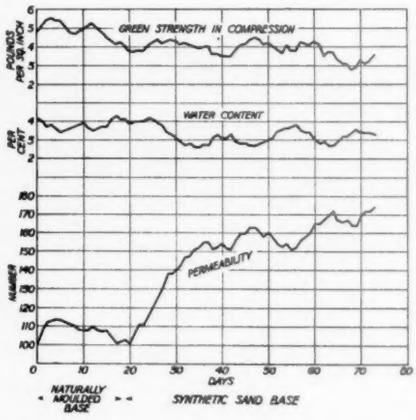

Fig. 8.—Varying Properties of Knocked-out Sand before Treatment.

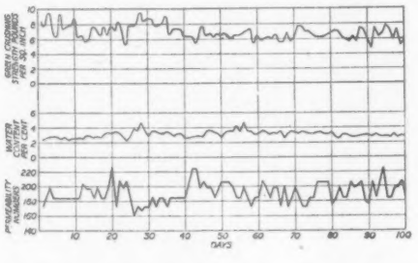

Fig. 9.—The Result of Control in Sand Preparation.

Fig. 11.—These Castings have been Cast with Green Sand Cores.

temperature, and should be sufficiently fluid to fill every part of the mould however intricate this may be. Although this property is desirable for all castings, it is most important when the castings are small, light and thin in section, or intricate in shape. This is precisely the type of casting usually made in green sand; hence the importance in green sand work of having a steel with a considerable life.

One method of manufacturing basic electric steel suitable for green sand steel foundry practice was described by two of the present authors in a Paper* last year, and this point need not, therefore, be further elaborated.

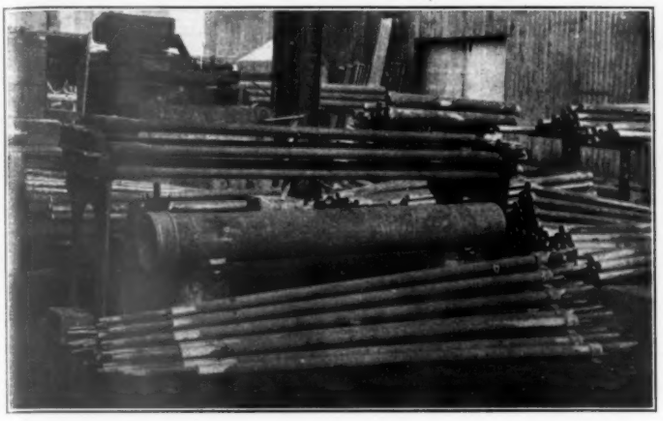

Fig. 10.—A Range of Pipes all of which Carry Green Sand Cores.

Sand Control

The properties of the sand used in a steel foundry for green sand work have an important effect on the results, and attention to this point is essential if success is to be achieved. Given suitable raw materials, the sand mixtures leading to successful results must usually be discovered by trial. When once they are found, uniformity in the sand supplied to the foundry floor must be maintained, especially when machine-moulding is adopted. This uniformity is secured by testing batches of sand immediately after mixing. Whether this testing is carried out with apparatus giving numerical values for such properties as the water content, permeability and green strength, or by "Old Bill," who relies on sight and feel, is a matter of no great consequence, unless "Old Bill" falls ill.

Sand for green sand moulding in steel should have a high permeability, and should, therefore, be fairly coarse in grain with as uniform a grain size as can be obtained. Its water content should be as low as possible, but a minimum amount of water is, of course, necessary to develop sufficient green strength. The high permeability will assist steam and other gases to escape from the mould, whilst the low water content will minimise the amount of steam generated during casting. Green sand casting has the advantage that during the pouring process a less proportion of the sand is heated to such a high temperature that its bond is permanently destroyed, and consequently a greater proportion of sand is re-usable than in dry sand work. It follows that with green sand moulding the percentage of make-up, whether of new sand, new binding material or both, is reduced. In spite of this economy, the surface of green sand castings is often at least as good as that of similar castings made in dry sand, since the refractoriness of the green sand mixture is at least as great as that of the dry sand mixture.

The property which is most liable to sudden variations is the water content, and differences in the amount of water present affect both the permeability and the green strength, so that it is essential to carry out frequent determinations of the percentage of water present. To obviate any troubles due to variations in water content this should be maintained constant within half per cent. For the same sand mixture too little water gives moulds which are weak and have a friable or murly surface, whilst too much water easily results in such defects as scabs and pin holes. It is advisable, therefore, to mill the backing sand as well as the facing sand in a green sand steel foundry, since without milling it is almost impossible to obtain uniformity in the sand mixtures. If the backing sand contains more water than the facing sand, water will move forward towards the surface of the mould when the moulds are standing, especially after closing, when the water vapour cannot readily escape from the interior of the mould. It is thus desirable that the backing sand should contain less water than the facing sand.

Fig. 12.—Irons for Green Sand Cores. Only the Bottom Half is Reinforced.

Synthetic Sands

In foundries in this country an increasing use is being made of sand mixtures consisting of silica sand milled with clay. In such mixtures the characteristics of both the sand grains and the clay are important. Sand grains which consist exclusively of silica are spherical in shape and have a smooth surface, and are the most refractory. Owing to their shape they touch at a minimum number of points, which is good for permeability but bad from a strength point of view, whilst the smoothness of their surfaces means that any coating of binding material put on the grains will not be held very firmly. Fig. 5 illustrates a silica sand of this type in which the grains are well rounded and have a smooth surface. If the grains are more angular the permeability is somewhat diminished, but owing to the greater area of contact between neighbouring grains the mechanical strength obtained by milling the sand with clay is improved. If at the same time the surface of the grain is rough, or if the grains are coated with

Fig. 13.—Because of the Few Castings Required, the Core Iron in this Case is Broken for Extraction.

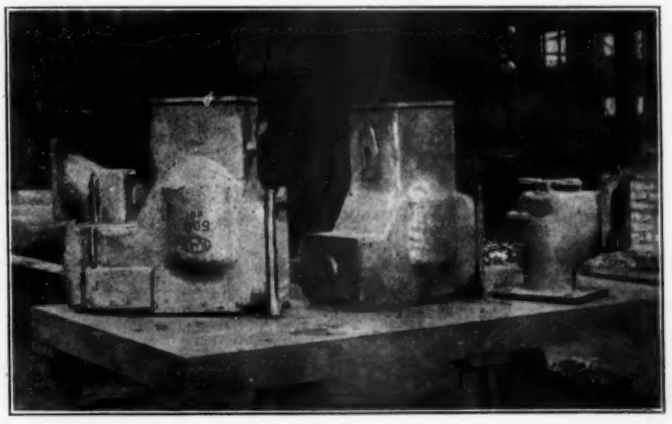

Fig. 14.—Intricate Castings Made in Green Sand.

* "The Manufacture and Utilisation of Electric Steel in the Foundry," C. J. Dadswell and T. R. Walker, Foundry Trade Journal, February 20, 1936.

a thin layer of tenaciously-held natural binding material, then any additional binding material milled with the sand will form a firmly-held layer round each grain. Fig. 6 illustrates a sand of this type in which the grains are sub-angular and are coated naturally with a thin film of clay, which is very difficult to remove.

Though any kind of clay may be used as a binding material, the ideal clay for this purpose would be both very refractory and highly plastic. Such a clay has not yet been discovered, and it is therefore necessary to adopt a compromise. Since the clay is less refractory than the silica sand, as little clay as possible should be used,

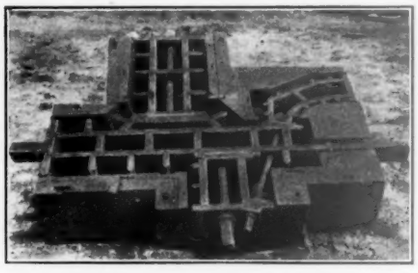

Fig. 15.—Core Box and Irons used for one of the Castings shown in Fig. 14.

so that the clay chosen should be highly plastic, with as great a refractoriness as can be secured. In this country the two clays commonly used are bentonite (a very plastic American clay) and ball clay (from Devon or Cornwall).

Table I gives the properties of sand mixtures made from the sand shown in Fig. 5, with different additions of bentonite and ball clay, whilst Table II gives the same information regarding mixtures of the sand shown in Fig. 6 with the same proportion of the same clay.

Table I.—*Sand with Smooth Well-Rounded Grains.*

Clay addition. Per cent.	Water. Per cent.	Permeability number.	Green strength. Lbs. per sq. in.	Dry strength. Lbs. per sq. in.
Ball clay 1½	1.0	216	2.0	7.7
2½	1.25	200	2.5	25.3
5	2.25	188	5.5	51.3
Bentonite 1½	1.5	216	1.5	20.3
2½	1.75	200	2.5	30.0
5	3.0	178	4.75	55.7

Table II.—*Sand with Coated Sub-Angular Grains.*

Clay addition. Per cent.	Water. Per cent.	Permeability. number.	Green strength. Lbs. per sq. in.	Dry strength. Lbs. per sq. in.
Ball clay 1½	2.0	178	3.75	26.7
2½	2.4	178	6.0	43.7
5	3.2	144	9.25	82.7
Bentonite 1½	2.1	188	3.75	27.4
2½	2.8	178	6.25	58.0
5	3.75	138	9.0	78.7

These illustrate the fact that with the same sand the two clays give almost the same mechanical strength. With the more angular sand, possessing a thin film of bond, however, the mechanical strength is substantially greater with the same clay content than for the smooth grain sand. The permeability of the mixture with the smooth rounded grains is rather greater than for the other sand. In any complete comparisons of clays it must be emphasised that besides the green strength in new mixtures there are other points of importance such as the length of useful life in repeated use, the nature of the surface developed on moulds, and the rate of loss of bond strength on heating.

Influence of Milling

In green sand practice of the type now being considered the silica sand is milled with the requisite amount of clay and water, the properties of the batch checked by testing, and the sand passed to the foundry floor for use. After the castings are knocked out, the sand is recovered and converted into backing sand with any necessary addition of new clay. Fig. 7 illustrates a typical installation for this purpose. The knocked-out sand arrives on a conveyor, and any contained steel or iron is removed by a magnetic separator. The sand is screened and transferred to a hopper, from which it is fed to a rotary mill, where it is mixed with new clay

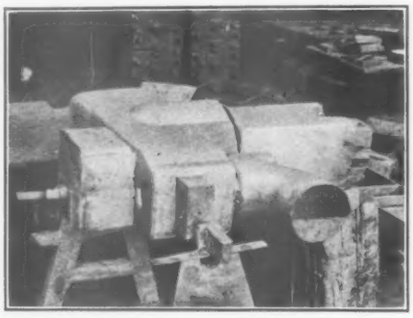

Fig. 16.—The Core Ready for Insertion in the Mould.

and water, and is charged into a skip, ready for use. The knocked-out sand naturally varies considerably in its properties, but after the treatment outlined the backing sand produced is uniform. Fig. 8 illustrates a significant change in the properties of the knocked-out sand during one period in the steel foundry referred to.

In order to eliminate the effects of wide daily variations in properties, and to emphasise instead the general trend in properties, the

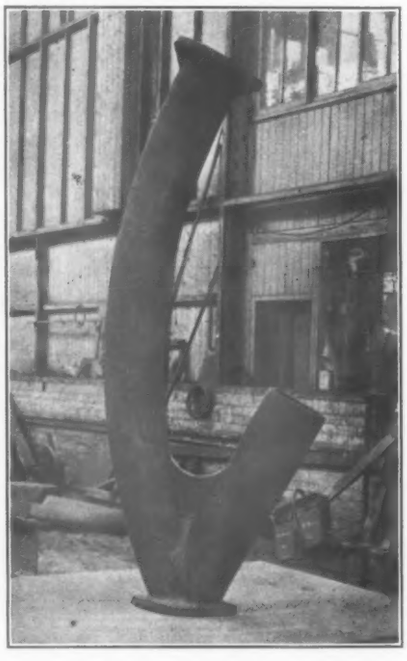

Fig. 17.—An Arch Pipe Casting Made from a Skeleton Pattern.

figures in the graph are shown in the form of a moving average curve of five days. During the first 18 days considered, the sand had a naturally bonded base, and its permeability number was about 105. Trouble was experienced in the foundry with defective castings, and it was decided to increase the permeability of the sand substantially. For this purpose progressive additions of a synthetic sand mixture were made, and the permeability number rose steadily to a figure of about 165, with very little change in either water content or mechanical green strength. With this change trouble in the foundry was eliminated.

The facing sand used is prepared from the above backing sand, milled with new sand and with fresh clay. To ensure uniformity the properties of every batch sent to the foundry floor are determined. Fig. 9 shows the results of 100 consecutive days' examination of this facing sand. It can be seen that the sand supplied to moulders day after day is reasonably uniform,

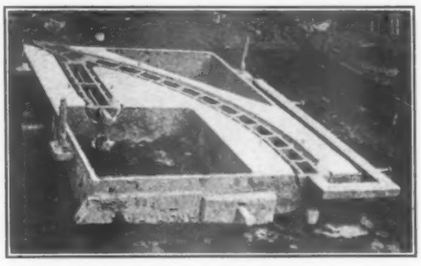

Fig. 18.—Skeleton Pattern of an Arch Pipe in the Mould. Note the Core Suspension.

and can be expected to give similar results repeatedly when used in the same way.

Type of Steel Castings Made

From what has been said already, it will be evident that some types of steel castings can be more readily made successfully in green sand than can other types. In this country, until recently, much larger green sand castings have been made in iron than in steel. The technique of making green sand steel castings up to about one ton each in weight is still not very widely known, though the number of steel foundries now making small green sand castings is rapidly increasing. Small castings suitable for repetition work lend themselves particularly well to green sand production in the steel foundry. Examples are castings for railway locomotives, carriages and wagons, colliery work, and castings for motor cars and lorries.

In the case of steel castings up to, say, one ton in weight, it is only when a foundry specialises in particular lines that they are manufactured in green sand, as the amount of special tackle required to make such castings in green sand is considerable.

Green Sand Iron Castings

The remarks already made regarding the economies to be secured by the adoption of green sand methods apply equally well whether the castings are in steel or in iron, and need not be further discussed. Green sand moulding has been practised in iron foundries for many years, and there is no need to do more than draw attention to castings which are not universally made in green sand, or which illustrate points of importance in the iron foundry. The economic advantages associated with green sand moulding are applicable to an even greater extent when the process is utilised for the production of cores, and this is a very promising field for development in the iron foundry. It is, of course, not practicable to make every core green, but it is easily possible to extend the use of green sand considerably.

The greatest opportunities for the use of green sand moulds and cores are found in the light iron castings foundry. Fig. 10 illustrates the production of pipes in such a foundry, and demonstrates the range of sizes dealt with. Each pipe mould, of course, must contain a core. If all these cores had to be dried the equipment required would be considerable, whilst the time

occupied and the handling involved would create problems which do not arise when the cores are used green.

Three castings which are often made with dry sand cores, and sometimes with dry sand moulds also, are shown in Fig. 11. They consist of a 12 in. sluice valve weighing 3½ cwts., a gas valve weighing 2½ cwts., and a gas offtake weighing 3½ cwts. All these are required to be perfectly sound and of good finish, all are machined to close limits, and in each case slight defects on the valve seats are sufficient to involve rejection of the castings. In the foundry under consideration all these are regularly made in

Fig. 19.—Semi-Bend Pipe Casting.

green sand throughout, the wasters over a period amounting to no more than 2 per cent., so that for such purposes the use of green sand cores is no longer in the experimental stage. Some details of the methods of making and using such cores are given below.

Core Irons

The essential principles in green sand core-making, namely, the form and construction of the core iron, are illustrated in Fig. 12. The basic idea is that only the bottom half of the core should contain an iron, and that iron should be so fabricated that it can be used repeatedly, even if a thousand castings are required. The iron in Fig. 12 is in three parts, which are fastened together by two screws. Soon after casting, the screws are loosened and the separate parts of the core iron are taken out of the casting. The pieces are then re-assembled and the iron is ready for use again.

In this way practically all the core is removed from the casting whilst it is still in the foundry and whilst the casting is still red-hot, which means that not much sand is destroyed by heat and not much lost by going to the fettling bay. This effects an important economy. A further point with these core irons is that the end bars, at the extremities of the core, are slightly larger than the rest. They sit on the bottom of the core box, whilst the remainder of the bars are ½ in. to ¾ in. from touching. These end bars are used for supporting the core as it sits in the mould, and usually come directly over a bar put in the moulding box for that purpose. The core box is a normal one.

The objection that can be raised to this manner of manufacture is that it involves the provision of a core iron that can become elaborate and therefore costly, and this point must be taken into account. There is a minimum quantity of castings required which warrants this kind of core iron, and the precise number in any given case is obviously governed by the cost of the core iron, which is different in each job and maybe from one shop to another. However, nothing slipshod will serve the same purpose; the iron must be well-fitted, and truly rigid when assembled, and incapable of slipping or twisting.

Fig. 13 shows the core box and iron of the sluice valve seen in Fig. 11. Here the core iron is in one piece and must be broken out of the casting each time. The reason for forsaking the principle of making a fabricated core iron is merely that the number required was too small to warrant the cost of fitting it up, and there is no object in saving money on a core to spend it on tackle. In this case the only money saved was by eliminating handling and drying.

A further group of castings made entirely in green sand, larger and more intricate than the previous casting, but still subject to the same specification regarding finish and cleanliness on machined surfaces, is shown in Fig. 14. Fig. 15 illustrates the core box and core iron for one of the castings. This time there are more pieces to the core iron and more screws to hold them together, but the principle is the same. In this case the core box has loose sides, the purpose being to get the core out of the box without undue damage, a concession to green sand practice. Fig. 16 shows a core ready for dropping into the mould.

None of the sand used is milled, no facing sand is used on the top half of the core, and only very little on the bottom. The procedure is to line the bottom of the box with about 1 in. of sand (which consists of a mixture of a little Worksop red with the floor sand), and then bed-on to this the iron which has previously been clay-washed. The bottom half is rammed to the level of the box joint and then vented. Bars are laid on to bring off the air at the centre, and the top half of the box is put on.

The sand for this half is riddled floor sand and the ramming is done by packing sand in at the ends of the box, after which the top half of the box is lifted off, the core made good where necessary, and vented down to the vent bar in the centre. Now the core is lifted out of the core box and the final finishing and blacking done. After blacking, a little oil is put round delicate edges to preserve them, and the core is ready for use. No chaplets are needed, because of the rigidity of the core iron, and none is used.

This core takes about two hours to make, and there is no additional cost, apart from the items which have already been mentioned. The moulder makes his own core on his own floor, and the method described is probably the

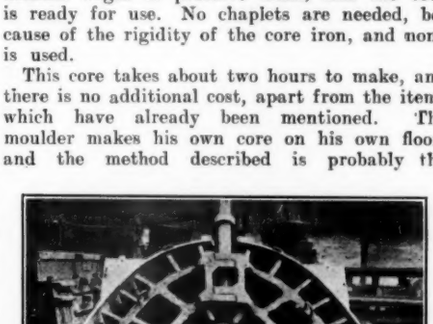

Fig. 20.—Core Iron Used for the Casting shown in Fig. 19.

cheapest which could be found for making such a core.

Figs. 17 and 18 illustrate an arch-pipe made out of a shell pattern, utilising the same principle. The core iron is of the same type except that it has an arm extension, the purpose of which is to balance the core and serve as a means of preventing either sagging or lifting. This is done by packing to projections on the moulding box and so avoiding the use of chaplets. The core here was formerly made in loam, and the gain in time, material, new core irons, and a more uniform weight of casting obtained by the method described is evident. Here, too, it is easy to observe the manner in which the moulding box is cut out to receive the end bar of the core iron, and to provide a means of support.

Fig. 19 shows a semi-bend pipe weighing 1 ton. Fig. 20 shows the core iron for this casting, and Fig. 21 shows the core ready for dropping into the box. The principles involved are precisely the same as those already referred to, but the shape and size of the casting are different. Many other examples of similar work could be given but they are unnecessary, since the same principles are utilised in every case.

Method of Production

Although the properties of sand used in an iron foundry are important, there is no central

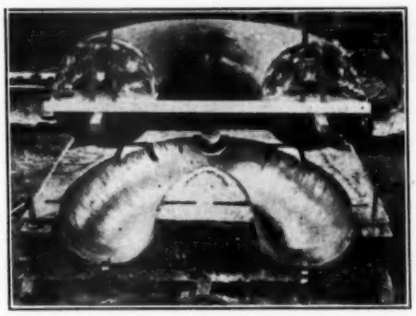

Fig. 21.—Core Ready for Inserting in the Mould.

control of the sand in the foundry where the castings illustrated above are made. Each man makes his own mixture from new sand, floor sand and coal dust without milling. No doubt the properties of each man's sand are slightly different, but the effects of such variations are corrected by differences in ramming, in the use of the vent wire and oil-can, by alterations in the position of the gates, or by pouring at a rather higher or lower temperature.

Each man pours his own casting and decides for himself what is the best pouring temperature. The gating of such castings is also a matter of importance. Gates should be arranged so that the mould can be filled quickly and quietly without the stream of metal striking a green sand core directly. At times, however, these conditions, though desirable, cannot be obtained.

It will be evident that in the foundry referred to, success in making iron castings of the type described, using green sand moulds and cores, has been obtained entirely from practical experience. Individual workers are to be admired for their craftmanship, but it must be admitted that any depletion of their ranks would have a very serious effect on the output of the foundry in such castings. This affords a good example of the truism that for certain types of work foundry practice is still an art, not a science. On the other hand, many iron foundries engaged in repetition green sand work, especially for the automobile and similar industries, find it necessary to control the properties of their sand mixtures by actual testing, on the same lines as the steel foundry referred to earlier in the present Paper.

Baldwins, Limited

At an extraordinary general meeting of Baldwins, Limited, held in London last week, a resolution was passed converting into stock the 1,500,000 4½ per cent. cumulative first preference £1 and 2,078,947 ordinary 4s. shares issued under the recent capital reorganisation scheme. It was also decided that each of the 471,000 unissued "A" preference £1 shares be sub-divided into five 4s. shares and that the resulting 2,355,000 4s. shares be converted into ordinary shares.

Non-Metallic Inclusions in Steel*

METHODS OF IDENTIFICATION

By R. GRAHAM and Prof. R. HAY

During the past few years a comprehensive study of the various slag systems has been in progress at the Royal Technical College, and the determination of the optical properties, colour, and general appearance of the various phases has formed an integral part of this work. It was realised that, whilst this information would be helpful for the identification of non-metallic inclusions in steel, further information would be necessary. With this end in view, various methods of examination were tried with varying degrees of success.

Microchemical Methods.—Optical methods having proved of limited application, microchemical methods were tried. These have been successfully employed to identify very small amounts of substances in solution, and a large amount of literature is available on the subject. The present problem presented one serious obstacle, in addition to the development of a satisfactory technique for the identification of certain elements in various combinations, namely, that it would be necessary to obtain the non-metallic inclusions, but not the matrix, steel, in the solution. This problem, however, was not faced immediately, as it was desirable in the first place to develop satisfactory tests, together with the requisite technique. The availability of a supply of various oxides and silicates from the work on thermal diagrams was of great assistance at this stage.

Specimens of FeO, MnO and FeO—MnO were selected for the first experiments. Tests were required to identify ferrous iron, ferric iron and manganese, either when present alone or in mixtures containing any two or all three of them. The precipitation test in which a phosphate reaction is employed was found unsatisfactory for the identification of ferrous iron under present conditions. A search was therefore made for a more suitable test. It is necessary for satisfactory work that the products formed in the test should be very slightly soluble in the reagents employed, and that the precipitate formed should not be of sub-microscopic dimensions. A list of the various salts which conformed to these conditions was prepared, but in practice the precipitate was amorphous in character in many cases. The most promising salt was that formed by acridine hydrochloride. It was also found possible to distinguish between ferrous and ferric iron by means of this test, the former giving green crystals and the latter deep red crystals. A 1 per cent. solution of acridine hydrochloride mixed with a 1 per cent. solution of ammonium thiocyanate was found to produce crystals which always grew in the same manner and, therefore, had the same crystal character.

Acridine hydrochloride readily breaks down, depositing acridine as long yellow crystals. It is, therefore, advisable to have a small amount of free HCl present to prevent decomposition. Ammonia must be absent, as it causes the breakdown of the chloride. Oxalic acid prevents the precipitation of the iron compound, but ammonium chloride does not interfere. Hydrogen peroxide not only prevents the precipitation of the iron compound, but also dissolves it if it has already been precipitated. Sulphuric acid prevents the precipitation of the iron compound, as also does a solution of mixed hydrochloric and nitric acids. Bromine retards the reaction, but does not completely stop it.

The tests for iron were found satisfactory in the presence of manganese, and to be applicable to fayalite.

A suitable test for manganese was obtained by again compiling a list of possible compounds, and testing them. Finally, manganese oxalate was selected as being the most satisfactory. Manganous oxalate, precipitated in neutral, slightly-ammoniacal or acetic-acid solution, gives a definite acicular crystalline precipitate.

Points to be Observed

The following points require attention. Acid manganous oxalate is decomposed by light; therefore, only a small excess of acetic acid must be present. The oxalate is not precipitated in the presence of sulphuric acid, oxalic acid or ammonium chloride.

Whereas sufficient manganese could be dissolved by acetic acid for testing purposes, it was found that dilute hydrochloric acid was necessary to dissolve the necessary amount of iron.

Having obtained satisfactory tests for iron and manganese under the required conditions, it now remained to be able to apply them to inclusions in steel. The next step was to protect the steel from the solvents used to dissolve the oxides and silicates. The type of substance required for this protection would have to be one which would wet the iron but would not wet oxides or silicates. Various reagents used in the flotation method of ore concentration were tried on a piece of carbonyl iron, but without success. Carbonyl iron, polished with pine oil, was found to be largely resistant to hydrochloric acid, but was not considered satisfactory. A number of the higher aliphatic acids were tried, and oleic, palmitic and stearic acids were found to be most satisfactory. The method of applying the protective medium was to polish the sample of carbonyl iron on a selvyt pad with alumina polishing powder mixed with stearic acid.

It now remained to be seen if the stearic acid would interfere with the desired reaction between inclusion and solvent. For this purpose an ingot of steel was cast, to which had been added iron oxide and manganese oxide, so that numerous large inclusions of these materials occurred in the cast ingot. On polishing a section of this ingot in the manner already described, and then attacking an area, containing inclusions, with hydrochloric and acetic acids, iron and manganese were found in the acid. Another ingot of carbonyl iron was prepared by deoxidising the liquid iron with aluminium and then adding an excessive amount of manganese oxide, so that the resulting inclusions were of this material. After polishing an area containing inclusions with stearic acid, and then attacking the area with hydrochloric acid, no iron was found in the solution. The technique adopted was to place a drop of the acid on the inclusion, and then wash the solution into the cup in a glass slide, add the necessary reagents, and examine the precipitate under the microscope. Stearic acid appeared to meet all the requirements. Numerous tests were then made upon inclusions in wrought iron and steels to be quite certain that only the inclusions were attacked. In these cases the solutions were not tested, but the iron and steel were carefully examined microscopically for evidence of attack, and inhibited specimens compared with specimens which were not so treated. In all cases N/10 HCl solution was employed, and the time of attack limited to 30 secs., which was found by experiment to be ample to dissolve sufficient of the inclusions for testing purposes. When the time of attack was prolonged to several minutes, using N/10 acid, the iron when inhibited was unattacked.

Having found that it was possible to apply this method of examination to inclusions in steel and wrought iron, it now remained to develop suitable tests for silicon, calcium and aluminium.

Test for Silicon

The compound finally chosen for the test for silicon was sodium fluosilicate, since hydrofluoric acid must of necessity be used to leach out the silicate inclusions. The procedure adopted was to etch the inclusion with hydrofluoric acid, transfer the drop to a protected glass slide, and add a drop of NaOH or Na_2CO_3 solution. If silicon were present, small hexagonal crystals of the double salt were observed on examination under the microscope. The hydrofluoric acid should be diluted four or five times. An objective of suitable focal length—⅔ in.—should be used, and the lens protected by collodion. The crystals are difficult to observe, since they have very nearly the same refractive index as the liquid. They are white, but appear to be tinged with pink, due to refraction.

Calcium tartrate was chosen as the most effective salt for the identification of calcium. This salt is easily precipitated in acid solution, and the conditions of precipitation are sufficiently elastic for the varying conditions encountered. A drop of the hydrochloric-acid solution is added to the inclusion, the test drop removed to the cup in the glass slide, and a drop of ammonium-acetate solution or a drop of 25 per cent. acetic-acid solution added, followed by a drop of ammonium or sodium tartrate. Crystals will be found to separate from the solution. It is essential that the normal tartrate be used, as no precipitate will be obtained if the acid salt be used. Sulphuric acid should be absent, as it will precipitate calcium sulphate, and this precipitate is usually too fine for identification. Excess HCl or too strong a solution of this acid inhibits precipitation.

Test for Aluminium

The test adopted for aluminium is a fluoride one. It is carried out by attacking the inclusion with hydrofluoric acid, and transferring the test drop to a protected slide. A drop of concentrated hydrochloric acid is added to it, then a drop of a solution of ammonium fluoride, and finally a small crystal of potassium chloride is placed at one corner of the liquid. If aluminium is present, small white octahedra and cubes are precipitated.

Having now obtained satisfactory tests for the common elements found in inclusions, these tests were applied in the first instance to a number of synthetically prepared slags.

Rhodonite was found to be resistant to hydrochloric-acid attack, so that hydrofluoric-acid solution had to be employed. Silicon was readily identified, and it was found possible to identify manganese by the test already given in the presence of hydrofluoric acid.

Fayalite, when attacked by hydrochloric acid, gave the iron test, and when attacked by hydrofluoric acid responded to the test for silicon.

A ternary melt containing FeO, MnO and SiO_2 was next examined. It was found necessary to employ hydrofluoric acid to attack this specimen, but all the tests gave satisfactory results. A quaternary slag containing the above-mentioned constituents, together with Al_2O_3, was next examined. Hydrofluoric-acid solution was again employed, and all tests satisfactorily obtained. The crystals obtained in the aluminium test, however, were rather small, but could be readily identified.

A piece of steel containing inclusions was examined. The microchemical tests revealed the presence of manganese, silicon, iron and calcium. A piece of the same steel was electrolysed by the method described by Treje and Benedicks in the Journal of the Iron and Steel Institute, 1933, Vol. 128, p. 205. The inclusions were caught in a collodion bag, and qualitatively examined by chemical methods. The results confirmed the microchemical tests.

* Abstract of a Paper in the Journal of the Royal Technical College.

The Freezing of Cast Iron*

By ALFRED BOYLES

The properties of grey cast iron may vary greatly without corresponding variations in composition or thermal treatment. The main structural difference in such cases is in the size and distribution of the graphite flakes, and such differences are usually attributed to some chemical element not shown by ordinary analysis or to some physical factor such as inclusions. Little systematic work has been done on the mechanism of freezing in cast iron and experiments were undertaken to deal with this problem as part of a programme of fundamental research on cast iron at the Battelle Memorial Institute.

Variation in type of structure of two cast irons, the composition and properties of which are given in Table I, was shown by microexamination. Iron No. 13 has normal graphite flakes, while iron No. 49 has very fine, lacy graphite arranged in dendritic pattern, the matrix in both being pearlite. In order to study the formation of dendrites, small melts of iron No. 13 were quenched in small crucibles at various stages of cooling through the freezing range, namely, from 1,310 to 925 deg. C. From the structure of the quenched specimens it was shown that primary austenite freezes out in the form of dendrites, which continue to grow down to the eutectic temperature, and that crystallisation of the eutectic liquid begins at centres which grow equally in all directions and form a cell-like structure. Segregation takes place in two stages: (*a*) between the primary dendrites and the liquid; (*b*) from the crystallisation centres of the eutectic outwards into the boundaries of the cells. Constituents formed during the freezing of the eutectic occupy the interstices of the dendrites, so that the graphite flakes and the phosphide eutectic are thus restricted by the size and distribution of the dendrites.

Table I.—*Composition and Properties of Cast Irons.*

Test No.	Composition.					Tensile strength. Tons per sq. in.	Brinell hardness.
	T.C. Per cent.	Si. Per cent.	Mn. Per cent.	P. Per cent.	S. Per cent.		
13	2.98	2.20	0.79	0.41	0.037	17.2	216
49	3.11	1.70	0.69	0.10	0.030	10.0	200

Alloys of Iron, Carbon and Silicon

In order to study the graphitisation of the eutectic without the complication introduced by phosphorus, quenching experiments were made on an alloy of iron, carbon and silicon made up from very pure materials and having the approximate composition of an ordinary foundry iron. The compositions of the two alloys prepared are given in Table II, and alloy No. 8 was used for the quenching experiments, quenching temperatures varying from 1,313 to 995 deg. C. Comparisons of the quenched structures of this alloy with those of normal cast iron show that the mechanism of freezing is essentially the same in both. The urge to graphitise is much stronger in the iron-carbon-silicon alloy and is clearly indicated by the amount of graphite formed in the lower part of melts quenched from the liquid state. The graphite flake structure of this alloy is highly abnormal and this difference persists after remelting. Since the normal cast iron contains considerable amounts of phosphorus, manganese and sulphur, the question naturally arises as to what influence these elements may have on the formation of graphite flakes.

Table II.—*Composition of Iron Alloys.*

No.	T.C. Per cent.	Si. Per cent.	S. Per cent.	Mn. Per cent.	P. Per cent.
7	3.06	1.91	0.007	Nil	0.010
8	3.49	2.01	0.007	Nil	0.008

Additions to Iron-Carbon-Silicon Alloys

To investigate the latter points, additions of phosphorus, manganese and sulphur were made to melts of the iron-carbon-silicon alloys with a view to determining the effect of these elements individually. Phosphorus did not produce much change in the graphite flakes, the same type of structure being obtained in four melts containing 0.30 to 0.70 per cent. phosphorus. Fine graphite occurs in each crystallisation centre and short flakes are present in the boundaries of the cells, and in all cases phosphorus segregated into the boundaries of the cell structure in the same manner as in cast iron. The matrix is ferrite with a small amount of pearlite, mainly around the phosphide eutectic. Manganese additions of 0.15 to 0.86 per cent. to alloy No. 8, and 0.16 to 1.22 per cent. to alloy No. 7, produced a peculiar type of structure in which fine graphite occurs in each crystallisation centre in the eutectic. Long flakes radiate from these centres forming a very pronounced rosette structure. With increasing manganese content the amount of pearlite increases gradually, but even the sample containing 1.22 per cent. manganese is not wholly pearlitic. The pearlite occurs chiefly in the boundaries of the cells. The structures produced by the manganese additions are quite different from the original alloys and also quite different from normal cast iron.

Sulphur additions varying from 0.018 to 0.294 per cent. and from 0.026 to 0.282 per cent. were made to alloys No. 8 and No. 7 respectively. Raising the sulphur to 0.018 per cent. rendered the matrix fully pearlitic and produced a very marked change in the graphite flakes, while in the sample containing 0.076 per cent. of sulphur the structure is identical to that of a normal, fully pearlitic cast iron. As the sulphur is raised the graphite flakes increase in size up to a maximum, after which they become smaller again. Similar results are obtained in alloy No. 7 except that a given percentage of sulphur exerted a greater effect in the lower carbon material. All the alloys in both series were fully pearlitic but showed no trace of mottling, a fact borne out by hardness tests. Quenching tests ranging from 1,313 to 995 deg. C. were made on 50-grm. charges of alloy No. 8 to which 50 mg. of sulphur were added and showed very definitely that graphite flakes do not begin to form until the eutectic begins to freeze, and that as soon as the eutectic is completely frozen the flake structure is essentially complete. Sulphur definitely increases the stability of the eutectic carbide and the experiments suggest a direct relationship between the rate of dissociation of cementite and the size of the resulting graphite flakes.

Graphitisation, which occurs during the freezing of the eutectic liquid may be considered as involving two types of action.

(1) Liquid → Austenite + carbide.

(2) Carbide → Austenite + graphite.

The first action is governed by the rate of cooling, which was constant during the experiments, and the second is governed by the inherent stability of the eutectic carbide. Between the two extremes of very rapid and very slow carbide dissociation a great range of graphite flake sizes may be produced with the same rate of cooling.

If graphite flake size in ordinary cast iron depends on the stability of the eutectic carbide, why does the carbide stability vary without any significant change in common analysis? Normal cast iron varies without any marked change in analysis or rate of cooling. The practice of superheating makes use of this fact, and another example is Norbury's process of adding titanium and blowing carbon dioxide through molten metal. Iron treated by the latter process has a structure which bears some resemblance to the iron-carbon-silicon alloys, and the question arises as to whether the fine graphite obtained is due to rapid graphitisation. Experiments were made to show that modified cast irons, when remelted, revert to normal structure, while alloys of iron, carbon and silicon remain unchanged. In the latter the fine graphite structure is inherent and reappears each time on repeated meltings and freezings. Manganese and sulphur additions affect the structure of iron-carbon-silicon alloys but are not removed by the modification of cast iron although modification affects the structure. Assuming that the size of graphite flakes in grey iron is governed by the stability of the carbide, it is impossible to interpret this variation in stability in terms of the usual variations in manganese and sulphur. Some other factors must be considered and based on composition; this calls for the presence of some material not shown by ordinary analysis.

"Oxygen Free" Cast Iron and Vacuum Melting

As oxygen has been suggested as a possible cause of the irregular behaviour of cast iron, a synthetic cast iron was prepared in a high-frequency induction furnace under hydrogen. This iron, which had the composition 2.70 per cent. total carbon, 1.67 per cent. silicon, 0.08 per cent. manganese, 0.031 per cent. sulphur, and 0.020 per cent. phosphorus, had the usual structure of white iron. From the standpoint of composition, the increased stability might be attributed either to a loss in oxygen or a gain in hydrogen, as the metal was superheated under hydrogen during the continuous stirring of induction melting which would favour both causes. If the carbide stability, therefore, is due to a lack of oxygen, the metal should remain white after vacuum fusion followed by cooling at the same rate employed in the hydrogen furnace, while on the other hand, if hydrogen is the cause of carbide stability, vacuum fusion should promote graphitisation by removing hydrogen. The alloy was therefore melted *in vacuo* in an alundum crucible at 1,370 deg. C. for 1 hr., when the structure was found to consist of ferrite and pearlite with much fine graphite and a few normal flakes. The Brinell hardness also dropped from 415 to 140.

Both vacuum fusion and melting in hydrogen are deoxidising processes, so that it is difficult to explain the change in structure of this alloy as due to the oxygen content. From the conditions under which the alloy was made, it seems more likely that the element involved is hydrogen.

Effect of Vacuum Melting on Normal Cast Iron

To determine the effect of hydrogen on carbide stability, experiments were made by melting cast iron of normal composition at 1,370 deg. C. *in vacuo*, in air at pressures varying from 100 to 400 mm. of mercury, and in air at atmospheric pressure. The gradual change in structure with increasing graphite flake size is attributed to the gradual removal of either hydrogen, oxygen, or nitrogen from the molten metal. To determine which gas was removed, samples of the modified metal were remelted in hydrogen, in air, and in nitrogen, when it was found that remelting in

(*Concluded on page* 336.)

* Summary of a Paper read at the New York Meeting of the American Institute of Mining and Metallurgical Engineers, February, 1937. Technical Publication No. 809, 59 pages.

Book Reviews

The Gun-Founders of England. By Charles Ffoulkes, Master of Armouries, Tower of London. Published by the Cambridge University Press, Fetter Lane, London, E.C.4. Price 21s. net.

The genesis of foundry work was probably the casting of celts for the splitting of flints; this was later replaced by bell founding, agricultural engineering, and the manufacture of ecclesiastical ornaments and domestic ware. Concurrently with these later developments, came the manufacture of guns, a business which has progressively expanded from the 14th century. In its earliest stages, the craft was essentially that of the smith; but for three centuries or more it was the joint perquisite of the iron and non-ferrous founders, and it is this phase which has been covered so thoroughly by Mr. Ffoulkes. In the presentation of his book, the author and his readers are indebted to the publishers for according the work such appropriate treatment in the choice of type, lay-out, binding and illustration. Nothing has been spared to produce a book worthy to take its place amongst contemporary standard English literature. The modern foundryman must not expect to receive any hints which will help him to improve his metal and castings, for the object of the book is to place on record the personalities of the industry:—Hogge, Walker, Baude, Parson Levett, Poppenrayter, the Arcanus family, the brothers Owen, John Browne, Schalch and Roebuck, and the foundries they erected in The Tower, at Woolwich, Vauxhall, Chelsea, Calais, Sussex, the Weald and Carron.

Little information is given as to details of manufacture, as, for obvious reasons, they have been kept secret throughout the ages. However, there is a translation from the manuscript work of Kritoboulos dated 1467, which describes the making of the great Dardanelles gun now at the Tower of London. This is supplemented by an extract from Gaya's Traité des Armes (1678) and by illustrations from Monge's classical work on L'Art de Fabriquer les Canons (1795). In every case loam moulding is indicated, and with the passage of time stress is laid upon the necessity of properly drying the mould and core. That these lessons were not properly learnt is described by the author when dealing with the gun-foundry established in 1684 at Moorfields (London). In May, 1716, during a visit to the foundry by a number of staff officers and "persons of quality," there was a considerable delay—blamed on to the melting department—and casting did not take place until eleven o'clock at night, when fortunately some of the "quality" had become tired of waiting and had gone home. When the mould was cast up, an explosion of such an intensity occurred that the casuality list was nine dead, eight so badly burnt that all except two were not expected to live, and this out of a total of twenty in the shop.

The general scope of the book has already been indicated, but in addition there are chapters dealing with "powder and shot" and "proof and range." In order that research shall be made easier for future writers, the author has been generous in provision of extracts from historical documents; has compiled a list of gun-founders of England and the Continents; has provided a good bibliography and an excellent index. The text is marred here and there by misprints, but insufficiently so to detract from the general worth of the book. As a contribution to the history of foundry work the book is of outstanding merit. Moreover, unlike the majority of books on the shelves of the foundrymen, this one is likely to appreciate in value with the passage of time.

V. C. F.

Chromium Plating (with Special Reference to its Use in the Automobile Industry). By Prof. Dr.-Ing. E. H. O. Bauer, Prof. H. Arndt and Dr.-Ing. W. Krause. Translated from the German by E. W. Parker. With Introductory Chapter on Electroplating Practice and the Properties of Chromium and Nickel Coatings by A. W. Hothersall, M.Sc. (Tech.). Published by Edward Arnold & Company, 41 and 43, Maddox Street, London, W.1. Price 25s. net.

The rapid expansion which has taken place in the use of chromium plating has been accompanied lately by the discontented mutterings of users who have been disappointed by poor quality of some of the products. In preventing this discontent from leading to a reaction against the use of chromium, this book should play a useful part.

It is not a handbook on the processes of chromium plating; it is based on an investigation, made in Germany, of the various methods available for the inspection of electrodeposits of chromium and of other metals which customarily serve as undercoats for chromium. On a large and diverse collection of chromium-plated parts in use in the automobile industry, tests for appearance, hardness, adhesion, wear-resistance, porosity, corrosion-resistance and ability to withstand temperature changes were made. All the known tests of repute were used, and for purposes for which no existing tests seemed reliable, as for porosity of coatings on zinc-base and aluminium castings, and for resistance to wear, new methods were developed. The variety of the coated parts tested, covering all types of basis metal and of undercoating, makes the work applicable to all commercial plated goods. Description of the tests is aided throughout the book by excellent reproductions of photographs of tested specimens.

A survey of the results obtained serves the threefold purpose of indicating the most reliable and convenient test for each of the properties, of giving useful evidence about the value of various undercoatings, and of providing excellent bases for future specifications. All that seems lacking is information about the conditions of deposition of the various coatings of chromium which were tested.

The inclusion of references to work, including that of American and British origin, outside the investigation which forms the backbone of the book, and a final bibliography of nearly 600 Papers, embracing electro-plating practice as well as testing, gives balance to a publication which should be most useful both to producers and to users of chromium plate.

S. C. B.

Modern Foremanship. By T. H. Burnham, B.Sc., B.Com., F.I.I.A., A.M.I.Mech.E., A.M.I.E.E., M.I.Mar.E., etc. Published by Sir I. Pitman & Sons, Limited, 39, Parker Street, Kingsway, London, W.C.2. Price 7s. 6d. net.

This book is written mainly with the intention of extending the horizon of the factory foreman, and with the hope that it might be of interest to other executives. The subject-matter deals with the acquisition of administrative knowledge and administrative attitude and is most explicit in defining and explaining this attitude necessary to the foreman in his dealings with the management, and more particularly with his dealings with the workmen.

The subject is dealt with under fifteen chapters—chapters I to V being mostly admonitions to the foremen. Chapters VI, VII and VIII are descriptions of the characteristics of the human material the foreman works with, and chapters IX to XV are discussions on the foreman's responsibilities under our modern industrial system. There is a good concluding paragraph and an excellent bibliography.

The book could, with advantage and interest, be read by the higher executives—the management and the directors. It would help in the selection of a foreman personnel capable of interpreting and putting into operation the managerial policy. The advantages of doing this intelligently and without undue friction will be obvious to progressive management.

In parts the book reads rather idealistic, as in the sentence on page 17, "it is of considerable practical value to remember in shop control that when you are emotional you are least rational." That remark could be supplemented with the thought that a good foreman must have the capacity for righteous indignation and the ability to exhibit it.

J. J. S.

The Freezing of Cast Iron

(*Concluded from page* 335.)

hydrogen caused a reversal in structure which could be repeated as often as desired, whereas any slight changes produced by remelting modified cast iron in air or nitrogen were not due to those gases but to the absorption of hydrogen from water vapour in the furnace atmosphere.

On the basis of the experiments described a hypothesis is proposed to explain the phenomenon of modification in cast iron.

(1) That cast iron is essentially an alloy of iron, carbon and silicon, the structure of which is profoundly altered by the presence of manganese, sulphur and hydrogen.

(2) That the type of structure called "normal" is due to the influence of the last three elements.

(3) That by varying the amounts of manganese, sulphur, and hydrogen a great variety of structures can be produced with the same rate of cooling.

The original Paper is illustrated with 70 photomicrographs showing the various structures obtained as a result of the experiments.

J. W. D.

Trade and the Coronation

Trade and industry throughout Britain is co-operating loyally in making the forthcoming Coronation of King George VI and Queen Elizabeth an event of strong and intimate significance to millions of employees. Not the least effective and generous method that is being widely adopted is the presentation of copies of the beautiful and comprehensive Official Souvenir Programme to all employees. It is a splendid gesture, one that will strengthen even further the ties between employer and employee at a time when all classes are united in hope for the reign which now begins.

The Official Souvenir Programme has been prepared with the King's full approval, and His Majesty is anxious that it shall be in the hands of as many of his subjects as possible, particularly those who, being far from London, will follow the events of the historic occasion by radio. As His Majesty's express wish, this Official Programme is published by and on behalf of King George's Jubilee Trust. So that those employers who distribute presentation copies will not only be paying a gracious compliment to those now in their employ, but will be helping to promote the welfare of those who will be the workers of to-morrow.

Many firms have extended their orders to cover their customers and clients. The result has been orders for many thousands of programmes wrapped with specially printed presentation bands. Supplies in any quantity are available from King George's Jubilee Trust, but only if ordered without delay. The programme is available in two editions—a standard edition at 1s. and a special edition at 2s. 6d. All applications should be addressed to King George's Jubilee Trust, St. James's Palace, London, S.W.1.

The Tyne Improvement Commission is to spend £636,000 on developments, including a new quay, at Tyne Dock, which it has acquired from the L.N.E.R. The scheme includes the building of a transit shed, coal-loading and bunkering arrangements, and cranes for discharging iron ore.

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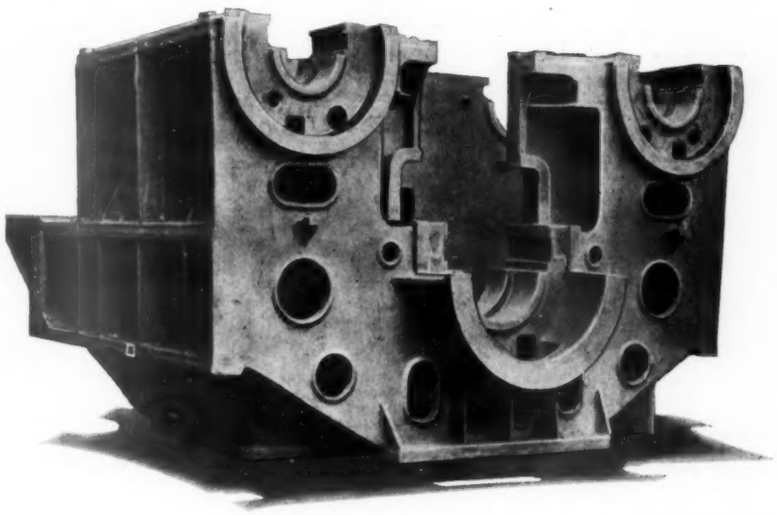

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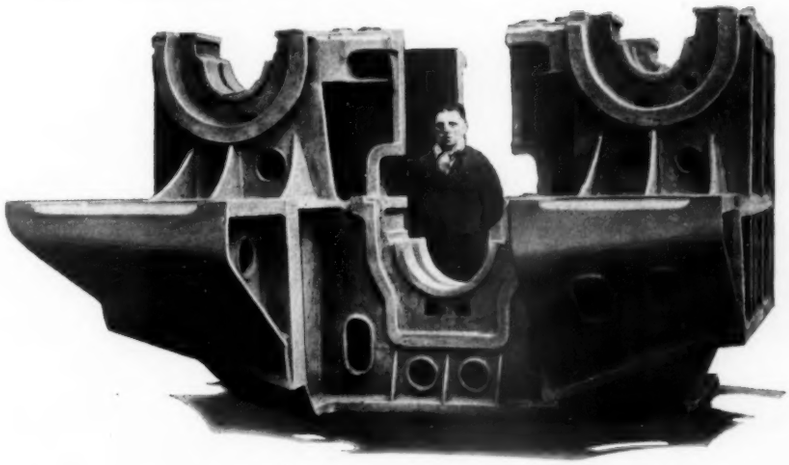

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Time Control

In our April 8 and 15 issues we published a Paper by Mr. Bernard Brown, B.Sc., on "Time Control in the Manufacture of Repetitive Castings." This was read before the East Anglian Section of the Institute of British Foundrymen and the discussion which followed is printed below.

Time *versus* Money Allowance

After Mr. C. H. Kain had proposed a vote of thanks, Mr. R. Dunnett, who seconded it, referred to the difficulty of using a stop watch in a foundry. In his opinion and experience, provided it was used with common sense there would be no difficulty or trouble whatsoever. He did not agree that the average man resented being timed, and once the employees appreciated they were being given a square deal, they would give an honest return. Over a period of 10 years, during which his foundry had been working on time study, a feeling of confidence had been built up with the men. In connection with obtaining standard data, he had reduced some 3,700 jobs to a formula which has been operating for over two years and had been producing satisfactory results. An important point in connection with foundry control was that the men must, as far as possible, be interchangeable and it was necessary to have a reserve man ready to fill any vacancy which might occur. Mechanised foundry piecework rates must include all operators in the shop, because each man was so interelated in the whole system that any delay affected the whole of the shop. As regards the system of payment, he personally preferred the money-allowance rather than the time-allowance system, because it was easier for the men to understand and much simpler for the payroll department. Mr. Dunnett favoured the settlement of piecework at the end of each job. If loss was made on a particular job, either the machine or the rate of working was wrong and if the latter, some error had occurred in the time allowance.

Weekly Payments

Mr. B. Brown, replying to Mr. Dunnett, said he had found that the average man resented the stop watch, but over a period of ten years, almost anything could be done by gradually building up confidence with the men. As regards paying jobs by the week, this depended to a certain extent on the length of the job, though when there were short runs, he much preferred payment by the week, and over long experience, had found this to be the better method. He disagreed with Mr. Dunnett and in his own experience with a number of factories, time piecework was far simpler than money piecework. He also stated that time piecework was capable of being operated by no more than half the staff required for money piecework.

Mr. L. Tibbenham then read a communication from Mr. V. Delport, chairman of the Costing Sub-Committee.

Methodical Records Essential

Mr. Delport wrote that the Paper was of considerable interest to him in view of its relation to the proposed uniform system of costing which the Costing Sub-Committee was endeavouring to establish. One of the principal recommendations of the system envisaged—and, in fact, of any costing system—was the correct and methodical keeping of records, and whilst time control was not actually a part of a costing system, a proper record of the time taken to effect various jobs was essential. Labour costs constituted one of the principal items of expenditure, and whether they were based on day work or piecetime work, wages must have a direct relation to time.

One of the principles of the costing system about to be recommended by the Sub-Committee was that overhead charges be allocated as a percentage of direct labour. When moulders were paid piecework wages, it was necessary that those wages be correctly calculated, otherwise there would be discrepancies in the allocation of overheads; in such cases it was not the costing system that was to blame, but the method of fixing the wages. As there should be a direct relation between the wages paid and the time taken to do a job, the same arguments would apply if the costing system had for its principle the allocation of overheads on a time basis. A personal opinion was that if times were always correctly calculated and checked in all foundries, there could be no objection to allocating overheads on a time basis.

Referring to Mr. Brown's sub-division of labour, the lower rates of wages paid to apprentices in a foundry must be taken into account in allocating overheads. It would be ideal if foundries were organised in such a way that the simple and cheap jobs could be given to the apprentices. In practice, where there was a variety of castings of different shapes and sizes produced, this could not be done systematically. The principle of planning the foundry output in advance was of interest in connection with the calculation of overheads based on so-called normal production.

With reference to the section headed "Standard Costs and Estimates," the author referred to the replacement or remaking of spoilt castings or wasters. Actually, it was the cost of making a waster that must be taken into account, allowance being made for metal returned to scrap.

The writer could not quite follow the example of standard costs cited in the Paper, as he had not the illustration available. With reference to the method used in estimating, he agreed with the general principle enunciated, but would ask on what basis the overhead percentage was arrived at where the author said that "overheads are expressed as £3 per ton based on the average weekly tonnage." Was the percentage based on labour or time? It was assumed that "average weekly tonnage" meant the tonnage of good castings produced.

Mr. Brown, in a written communication, replied to Mr. Delport's discussion as follows:—

Allocation of Overheads

Keeping correct and methodical records was actually the basis of the system described. Personal experience was that piecework or any system of incentive usually failed lamentably when it was not definitely associated with a foundry order or lay-out. It would have been noted that in the standard-time system described, each moulder was given a lay-out which gave the type of job, the weight of castings, times allowed, etc. These lay-outs were passed through with the job and finally returned to the office when they were used for costing purposes.

Although the allocation of overheads was outside the scope of the present Paper, it could be stated that in general there was no reason why overheads should not be applied on direct labour as was used commonly in the machine shop and other manufacturing departments. However, this depended largely upon the class of work undertaken by the factory, and the overheads applied on a tonnage basis might be quite satisfactory if the class of casting and weekly tonnage were reasonably constant.

So far as overheads generally were concerned, the author had found that it was essential that these be checked at least monthly as otherwise it was probable that the nominal percentage would be applied month after month when actual conditions had changed so that considerable errors were incurred.

The overheads of £3 per ton referred to were based on the average weekly tonnage, no percentage being deducted, but the total overheads of the factory were divided by the average weekly tonnage giving a figure of £3. Certainly the "average weekly tonnage" meant the tonnage of good castings produced. It was, of course, appreciated that this method might not be generally applicable where the work varied considerably.

Considering the various interesting points brought forward by Mr. Delport, the author regretted that the scope of his Paper did not embrace foundry control generally instead of simply time or labour control.

The Metallurgist and His Mixture Cost

Mr. H. H. Shepherd said he could not allow the statement that a metallurgist was unable to reduce his mixture cost to remain unchallenged. He did not know any foundry where the metal mixture had been standardised in such a way that the metallurgist could not have made some saving, unless the standardisation had been brought about largely by himself. One could not standardise to any definite degree, although the metallurgist had certainly to bear in mind a number of factors which were not always confined to quality.

He had seen a certain amount of trouble caused by the use of the stop watch. He wanted to make it quite clear that the whole system of time control was useless if the human element was not considered. This was the only point he wanted to stress. The question of the man going in fear of losing his job did often arise, and mechanisation ultimately meant that the man in the foundry had to be careful that he did not become replaced labour. This was a vital point to foundrymen.

Time Control's Influence on Apprentice Labour

Mr. W. L. Hardy said that he had worked piecework for fifteen years, and the machine moulder only worked on a piecework rate to increase his money. He had found great trouble in getting lads to enter the foundry, and if this matter of splitting seconds was to be pursued, there would be a still greater shortage. As regards output, any practical man could tell a manager more accurately how many moulds could be made than a man who had dealt only with machine shops and the like, since the foundry could not be regarded in the same way. Picking up sand was vastly different from picking up a micrometer.

Mr. Brown said that time control was essentially fair and any "twisting" would certainly fail. As regards reducing the man's earnings, he had always been able to pay the man more, and, so far, had reduced the price of the product at the same time. If time control was properly applied, the man worked harder, but was paid proportionatly more for doing so. The main object was to eliminate delays, since most of the waste was not that the man did not work hard enough, but was idle a large part of the time. He disagreed with the suggestion that the practical man knew more about output than the time-study man or rate-fixer; the latter was a specialist in his own class of work. He also emphasised the accuracy that could be obtained in presetting times from built up constants.

Waiting Time

Mr. Slater asked how the men could make a bonus if, as had happened, there were five gangs of men and only one crane, as in this case four gangs would have to wait to be able to use it. There appeared to be some difficulty about this question, which it eventually transpired was connected with heavy castings in singles.

Mr. Tibbenham explained that Mr. Brown's Paper dealt only with repetitive castings. Mr. Brown, confirming this statement, stated that he could not reply to the particular question, but in any case waiting time could not itself be

(*Concluded on page* 340.)

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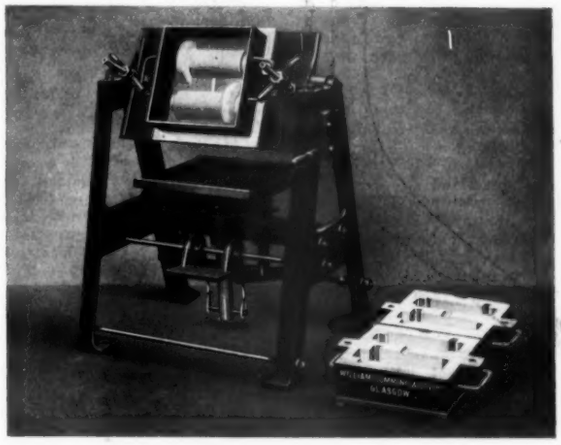

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The Week's News in Brief

Trade Talk

Baker Perkins, Limited, engineers and founders, of Westwood Works, Peterborough, are making extensions to their works.

John Readhead & Sons, Limited, South Shields, are to build a 9,000-ton steamer for Sir A. M. Sutherland, Newcastle-upon-Tyne.

The Japanese Privy Council has approved an emergency decree exempting pig-iron and steel from import duty until March 31 next.

C. A. Parsons & Company, Limited, Heaton, Newcastle-upon-Tyne, have received a contract valued at £60,000 for turbo-alternating plant for Edmonton, Alberta, Canada.

The Peterborough Die Casting & Machine Company, Limited, manufacturers of pressure die-casting machines, have acquired new premises in Princes Street, Peterborough.

Blast-furnacemen in Scotland have received an increase of 5 per cent. in wages under the conciliation agreement between the Iron and Steel Trades Confederation and the employers' association.

A fire occurred last Monday night at the Blackness Foundry of Urquhart Lindsay & Robertson Orchar, Limited, Dundee. Little damage was done and arrangements have been made to carry on business as usual.

Ellerman Lines, Limited, London, have placed an order with William Gray & Company, Limited, West Hartlepool, for two high-speed cargo ships of 4,250 tons each. The engines will be constructed at the builders' Central Marine Engine Works.

An explosion occurred at the Darlington Forge last Saturday, when a 40-ton steel casting was being poured. As a result, Frank Cooke, foreman moulder, and Henry Crabtree, a labourer, were killed, and four other men were injured, one seriously.

S. P. Austin & Son, Limited, Sunderland, have received an order for three 1,600-ton colliers from Stephenson, Clarke & Associated Companies, Limited, of London. The engines will be built by the North-Eastern Marine Engineering Company, Limited, Sunderland.

Extensive damage was caused last Monday by a fire which occurred at the engineering works of Blake, Barclay & Company, Limited, Macdougall Street, Greenock. Most damage was done to the pattern store, but arrangements have been made to carry on business as usual.

The apprentices and young men on strike at the Zenith Works, Thornliebank, near Glasgow, of Henry Wiggin & Company, Limited, resumed work on April 14, having received an undertaking from the firm to grant increases. Negotiations were made last Tuesday for an agreement for standard rates and conditions.

The Clyde Alloy Steel Company, Limited, have installed a new gas-fired heat-treatment furnace in their newly-acquired premises at Toll Street, Motherwell. At the company's main works at Craigneuk a new high-frequency electric induction furnace, built by the Electric Furnace Company, Limited, London, has been put into commission.

The National Union of General and Municipal Workers stated on Monday that an application had been made to the Iron and Steel Trades Employers' Association for increases in wages for members engaged in the iron and steel industry throughout the country. It is requested that the basis earnings of adult workpeople with base wages between 5s. 2d. and 7s. 8d. employed in the heavy steel trade covered by the Association be increased by 15 per cent. In its letter to the Employers' Association the Union asks for a conference to consider the claim.

Under an agreement between a joint committee of the light metal trade unions and the National Light Castings Iron Founders' Federation, employees in the light castings industry will receive wage increases from May 17. The agreement provides for a 4s. a week increase to all male employees over 21, with proportionate increases to youths and apprentices under 21, and to piece-workers; 2s., 1s. 6d. and 1s., according to age, for women. Separate negotiations for a differential rate for patternmakers are still proceeding between the United Patternmakers' Association and the employers, whose last offer has been rejected by ballot.

Time Control

(*Concluded from page* 338.)

cured by any paper work, but only by reorganisation of the foundry itself. He would state that all waiting time which was not the fault of the man would normally be paid for at day-work rate and logged against the department.

Day-Work Rate Guaranteed

Mr. McInnis inquired whether it was Mr. Brown's experience that in this country the men were guaranteed day-work rate. In America, day-work rate was not guaranteed, and therefore the men had even more incentive to work.

Mr. Brown replied that, generally speaking, in this country the day-work rate was guaranteed, and he personally would not subscribe to any system where day-work was not guaranteed.

Mr. McInnis said that if there was a big variation between the day-work rate and the bonus, there was an incentive for the man to work harder, but, of course, if the day work was not guaranteed, he had to work hard to live.

Mr. Brown said that piecework prices were set for a man to earn. If he did not earn them, he was not a success. There was a certain class of man that did not want to work and was satisfied with a low rate.

Mr. Tibbenham said that if anyone queried whether the telephone system illustrated worked in practice, he would be pleased to see them at his works, where they could see it in operation.

Contracts Open

Auckland, June 8.—Three five-ton electric semi-portal jib cranes, for the Auckland Harbour Board, New Zealand. Mr. C. R. Butters, c/o H H. Lloyd & Company, 41, Cheapside, London, E.C.2.

Norton-in-Hales, May 6.—2,280 yds. of 3-in. spun-iron pipes and 200 yds. of 2-in. cast-iron pipes, for the Drayton Rural District Council. Mr. H. Crabtree, engineer, 21, Pillory Street, Nantwich, Cheshire.

Rothesay, April 26.—Brasswork, tools, and tubes and fittings, for the Town Council. Mr. T. S. Lockhart, Gas Department, Rothesay.

Simla, May 3.—20 kw. direct-coupled crude oil engine-driven d.c. generating set, for the Indian Stores Department. The Department of Overseas Trade. (Reference T.Y. 31,268.)

New Companies

(From the Register compiled by Jordan & Sons, Limited, Company Registration Agents, 116 to 118, Chancery Lane, London, W.C.2.)

Ormerods (Coventry), Limited, Little Park Street, Coventry.—Capital, £1,000. Electrical engineers, die casters, etc. Directors: S. H. King and M. R. Rakusen.

Ballantyne, Burlake, Limited, 47, Victoria Street, London, S.W.1.—Capital, £5,000. Engineers, founders, etc. Directors: M. H. H. Ballantyne and H. P. Lake.

Oxley Engineering Company, Limited.—Capital, £100. Metal founders, forgers, welders, etc. Subscriber: D. A. Philips, 42, Hollycroft Avenue, London, N.W.3.

Challis Bros., Limited, 210/212, Upper Street, Islington, London, N.1.—Capital, £5,000. Engineers, ironfounders, etc. Directors: E. W., G. A., H. W., E. A., G., and F. Challis.

Correction.—In Mr. J. Shaw's article on "Ingot-Mould Life," published in the Journal last week, on page 309, column 3, under the caption "Oxidation," the text reads:—"Anyone who attended the Liège Foundry Conference . . . will be surprised at the active use of deoxidisers in Belgium and France." This should have read: ". . . will not be surprised . . ."

Personal

Mr. J. M. Ingram has joined the commercial staff of the Park Foundry, Limited, Belper, near Derby.

Mr. Charles Currie has been elected President of the West of Scotland Association of Foremen Engineers.

Mr. A. C. Gardner, engineer to the Clyde Navigation Trust, has been elected President of the Institution of Engineers and Shipbuilders in Scotland for the ensuing year.

Mr. A. J. Ward, assistant managing director of Thos. W. Ward, Limited, Sheffield, who is in a nursing home following a serious operation, is reported to be making satisfactory progress.

Mr. C. E. Williams, of John Williams & Sons (Cardiff), Limited, accompanied by his wife and daughter, is now finishing a trip round the world, and is due to return to this country on May 11.

Mr. Cecil W. Murry, managing director of George Fletcher & Company, Limited, engineers and ironfounders, of Derby, has been appointed President of the Derby and Derbyshire Chamber of Commerce.

Sir Robert Hadfield, chairman of Hadfields, Limited, has received notification that he has been raised to the distinction of Commander of the Legion of Honour. Sir Robert was made an Officer of the Legion some years ago for services to science.

Lt.-Col. J. H. M. Greenly, C.B.E., M.I.E.I., M.A., was elected chairman of the British Non-Ferrous Metals Research Association, in succession to the late Mr. Thomas Bolton, at a meeting of Council of the Association held on Monday. Col. Greenly, who is deputy chairman of Babcock & Wilcox, Limited, has been closely connected with the non-ferrous metals industry since 1920, and with the Research Association since 1925, and has served as a member of Council almost continuously throughout the latter period.

Wills

Denny, Sir Archibald, Bt., LL.D., director of William Denny & Bros., Limited	£153,096
Lane, William Ross, ironfounder, late of Hazelwood, Bridge of Allan, Stirlingshire	£63,822

Obituary

Mr. John Pearson, an ironmoulder employed by J. F. Low & Company, Limited, Monifieth, has died, aged 45.

Mr. Crawford James Sturrock, formerly a partner in Sturrock & Murray, Limited, engineers, Dundee, has died.

Mr. Ernest E. Sawyer, who was a director of the British Aluminium Company, Limited, until his retirement in 1934, has died.

Mr. J. R. Welsh, who was the commercial manager of the Redheugh Iron & Steel Company, Limited, died on April 8, at the age of 58.

Mr. William Dunlop has died, aged 69. He was an ironmoulder employed by Andrew Strang & Company, Limited, and retired many years ago.

Mr. Robert Marshall, who, prior to his retirement 15 years ago, was for 45 years in the employment of Falkirk Iron Company, Limited, has died at the age of 80.

Mr. John George Kearsley, the last member of Kearsley & Company, ironfounders and agricultural implement makers, Ripon, died last week, in his 64th year. He was principal of the firm up to their dissolution a few years ago.

Forthcoming Events

APRIL 29 AND 30.

Iron and Steel Institute:—Annual Meeting at the Institution of Civil Engineers, Great George Street, London, S.W.1; Annual Dinner (April 29) at the Grosvenor House, Park Lane, London, W.1.

MAY 5.

Institute of Metals:—Twenty-seventh Annual May Lecture: "The Flow of Metals," by Prof. E. N. da C. Andrande, at the Institution of Mechanical Engineers, Storey's Gate, London, S.W.1, at 8 p.m.

Institute of British Foundrymen

APRIL 24.

West Riding of Yorkshire Branch:—Annual general meeting, at the Technical College, Bradford, at 6.30 p.m.

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Raw Material Markets

While there has been no official announcement as yet, it is fully anticipated that prices of iron and steel will be advanced at an early date. Much speculation exists as to the exact amount of the increases. However, consumers are more concerned with the supply position and they would willingly pay extra for further supplies. In fact, it is reported that higher unofficial prices have already been paid in certain districts.

Pig-Iron

MIDDLESBROUGH.—A good tonnage continues to be despatched against contracts, but it is difficult to obtain any additional supplies under existing conditions. Stocks at the makers' works are negligible. Producers prefer to await the publication of the revised prices before entering into new forward commitments. No. 3 G.M.B. is quoted at 81s. and No. 1 foundry at 83s. 6d. for delivery in the Middlesbrough area. Supplies of hematite also are scarce, but users who can prove the necessity can generally procure extra tonnages, especially of East Coast material, which is rather more plentiful than the West Coast iron. Exports continue to be fairly well maintained. The first shipment from the Tees to Italy for a long period was made during the past week.

LANCASHIRE.—Consumers of pig-iron in this area continue to demand heavy deliveries against contracts, and, on the whole, they have been well treated in this respect. For delivery to Manchester and district, offers of Staffordshire and Derbyshire No. 3 foundry iron are on the basis of 89s. per ton, with Northants at 87s. 6d., and Derbyshire forge iron at from 84s. to 86s. West Coast grades of hematite are quoted on the basis of 106s., with East Coast material at 105s. 6d., subject to rebate. The price of Scottish foundry iron remains very firm at 106s. per ton, and supplies are extremely difficult to obtain.

MIDLANDS.—There is little likelihood of any material increase in production in the near future, and consumers will have to be content with the present system of deliveries. In some cases contract renewals are being made, but, otherwise, little new business can be arranged. Northants No. 3 continues to be quoted at 83s. 6d. and Derbyshire, Lincolnshire and North Staffordshire No. 3 at 86s., delivered to Birmingham and Black Country stations. Supplies of special irons are not so plentiful as has previously been the case. Low-phosphorus iron is quoted around £6 and refined iron is about £7 5s., minimum. Prices of hematite are unchanged at £5 9s. 6d. for West Coast mixed numbers, £5 8s. 6d. for East Coast No. 3 and £5 8s. for Welsh mixed numbers, delivered to Midland stations.

SCOTLAND.—New inquiries are having to be returned to the senders in this area, as makers generally are fully sold over as long a period as they are disposed to negotiate. Producers possess no stocks and all deliveries have to be made from current output. The official minimum price of No. 3 foundry remains at 88s. f.o.t. furnaces, while No. 1 foundry is at 90s. 6d. per ton. It is reported that business has been done in No. 3 foundry at as much as 93s. per ton. No. 3 Cleveland iron continues to be quoted at 84s. f.o.t. Falkirk and 87s. f.o.t. Glasgow, but these figures are purely nominal, as little iron is available. Supplies to local steelworks have been further restricted recently by the decline in imports of Indian basic iron. Mixed numbers of hematite are officially quoted at 98s., with British and Indian basic at 82s. 6d., both less 5s. per ton rebate, and f.o.t. steelworks.

Coke

For delivery to Birmingham and Black Country stations, best Durham coke is officially quoted at a minimum of 46s. 6d., while Welsh coke varies in price from 47s. 6d. to 57s. 6d. per ton. At these advanced quotations rather less business has been done, but consumption is heavy and requirements continue to increase, so that further activity may be expected.

Steel

While most of the steelworks are operating practically at capacity, new business has been on a restricted scale, says the official report of the London Iron and Steel Exchange. Transactions are limited, as the majority of consumers have covered their requirements so far as possible, while the steelworks are generally booked as far ahead as is considered prudent under existing conditions. The world scarcity of steel is still acute, and arrivals of steel from Cartel countries are considerably in arrears. The position in the semi-finished steel department does not materially change, and pressure to obtain supplies is unrelaxed. The British works are operating at capacity, but the imports of Continental steel are considerably below normal and operations at the consuming works are being affected. Lately, however, a slight improvement has been noticeable in the position. The demand for finished steel is still insistent on home and oversea account and shows no signs of declining.

Scrap

Steelworks, in particular, are adversely affected by the shortage of scrap, and operations at many consuming plants are restricted in consequence. The control scheme for the selling of scrap is not yet complete, but an early announcement is expected in this connection. Where contracts have been arranged only small parcels for early delivery are generally involved.

Metals

In their weekly metal market report, Henry Gardner & Company, Limited, state that "the general feeling of *malaise* which has been hanging over the markets for the last two or three weeks has continued, and the rallying power after liquidation shown by commodities has not been very convincing. On the other hand, markets all round seem to have got into a vicious circle, wherein commodity and share values have reacted on one another to accentuate the downward tendency. Moreover, the late spring and early summer is usually a period of the year when normally some recession in demand is witnessed. All these factors are ones which can be very transitory, and, unless, they persist, on the present volume of trade and the consequent short supply of materials, are not likely to cause any considerable alteration in the latter. On the other hand, the production of gold still continues to increase and it may be that the recent rumours will one day prove to be not so unfounded as many people think." The reference to gold is of considerable interest; as was witnessed recently, when it was suggested that the United States intended to lower the price of gold, the commodity markets in this country were severely affected and prices sharply declined.

Copper.—Rumours of a revival of copper restriction have been in circulation recently. Conditions generally have been steady. Consumers are, on the whole, well covered and appear to see little reason for obtaining further supplies for the present. That production is on an increasing scale may be seen from the statistics for February and March, which are as follow:—World blister output, 185,750 tons (February), and 204,150 tons (March); world refined output, 172,900 tons, and 191,000 tons; world consumption, 164,250 tons, and 187,800 tons; world refined stocks, 330,075 tons and 308,450 tons. Domestic copper in the United States has been sold at 14½ cents per lb., which is a reduction of 1 cent.

Metal Exchange quotations were as follow:—

Cash.—Thursday, £64 2s. 6d. to £64 5s.; Friday, £62 to £62 2s. 6d.; Monday, £59 5s. to £59 7s. 6d.; Tuesday, £55 10s. to £55 15s.; Wednesday, £60 10s. to £61 10s.

Three Months.—Thursday, £62 12s. 6d. to £62 15s.; Friday, £60 17s. 6d. to £61; Monday, £57 10s. to £57 12s. 6d.; Tuesday, £53 10s. to £53 12s. 6d.; Wednesday, £57 7s. 6d. to £57 12s. 6d.

Tin.—The market is quiet and the outlook uncertain. Consumption remains on a good scale—around 200,000 tons a year. According to the American Bureau of Metal Statistics, world's production of recoverable tin in ore in February totalled 14,279 long tons, against 14,832 tons in January. It has been officially announced from Kuala-Lumpur (F.M.S.) that no general reassessment of tin producers in the F.M.S. will be undertaken during the existing period of restriction. The central committee, however, will retain powers to revise individual assessments where and when such revision is in their opinion essential.

Official quotations were as follow:—

Cash.—Thursday, £272 10s. to £273; Friday, £265 10s. to £266; Monday, £258 to £258 10s.; Tuesday, £249 to £250; Wednesday, £261 to £262.

Three Months.—Thursday, £270 to £270 10s.; Friday, £263 15s. to £264; Monday, £256 10s. to £256 15s.; Tuesday, £245 10s. to £246; Wednesday, £256 15s. to £257.

Spelter.—Consumers have shown rather more interest in the market, but difficulty is still being experienced in obtaining adequate supplies, especially of the high-grade metal. The general statistical position of the market is quite satisfactory, but, on account of the rather dull interest of buyers, it would not be surprising were a decline in prices to take place. In the United States, also, buyers are not "in the market" to any appreciable extent.

Daily market prices:—

Ordinary.—Thursday, £26 6s. 3d.; Friday, £26; Monday, £24 12s. 6d.; Tuesday, £22 7s. 6d.; Wednesday, £23 13s. 9d.

Lead.—A quiet tone also rules in this market, and consumers generally show little active interest. Deliveries under contract are satisfactory and users are able to obtain their full requirements. Consumption in the United States is well maintained, but little new business has been transacted.

Day-to-day quotations:—

Soft Foreign (Prompt).—Thursday, £25 7s. 6d.; Friday, £25 1s. 3d.; Monday, £24 1s. 3d.; Tuesday, £23; Wednesday, £24 11s. 3d.

Company Meeting

A year of progress was recorded by MR. FRED WILDBLOOD (chairman) at the first ordinary general meeting of Blythe Colour Works, Limited, held at the North Stafford Hotel, Stoke-on-Trent. The chairman said that the net profit for the year, after making adequate provision for depreciation, amounted to £35,718, which represented an increase of £5,262 as compared with the previous year. There was a mistaken impression that they were paint manufacturers. They were not. They did, of course, make the more expensive bases which were used by manufacturers of artists' colours and high-class paints, but, primarily, they were manufacturers of colours, glazes and enamels for the ceramic industry. The company had a high reputation for its products, and its vitreous enamel department was progressing steadily. An increasing number of manufacturers, whose customers were previously satisfied with ordinary paint or stoved-enamel finish on their goods, were now finding it necessary to supply a vitreous-enamel finish, because of its permanence and its fire and stain-resisting qualities. Trading conditions on the Continent, the chairman added, had remained unsettled and, indeed, difficult, and the satisfactory increase in their turnover was entirely attributable to the improvement in the company's home trade. It was very gratifying to note that this improvement had, so far, been more than maintained during the current year. Work on the extensions to the factory had continued steadily, and had involved an expenditure of £19,634. It was expected that these extensions would be completed during the current year, when a beneficial effect should be reflected in the company's trading.

Company Reports

Robert Stephenson & Company, Limited.—Dividend of 2 per cent. for the year.

Murex, Limited.—Interim dividend of 1s. 6d. per share, or 7½ per cent., on the £1 ordinary share.

Ideal Boilers & Radiators, Limited.—Net profit for 1936, £229,813; 10 per cent. tax free dividend on the ordinary shares.

Aluminium Corporation, Limited.—Profit for 1936, £11,125; debit brought in, £8,462; credit carried forward, £2,663.

C. & W. Walker, Limited.—Profit for year to January 31, £30,834; brought in, £1,631; preference dividend of 7½ per cent., £3,000; dividend on the ordinary shares of 10 per cent., £9,530; ordinary share bonus of 1s. 6d. per share, £7,147; to general reserve, £7,500; carried forward, £5,289.

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YORKSHIRE SAND

Yorkshire Sand is of a synthetic nature, its production being under careful laboratory control. Perfect standardization is obtained with the various grades, suitable for light and the heaviest steel castings.

It is because of the refractoriness of the sand and of the toughness of the mould surface that castings made with Yorkshire Sand are distinguishable by their excellent finish.

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SWANSEA OFFICE: Metropole Chambers, Wind Street, Swansea. Telephone: 3680. Telegrams: "Genefax, Swansea." (Mr. D. Hood-Williams.)

CARDIFF OFFICE: 17, Windsor Place, Cardiff. Telephone: 5796. Telegrams: "Genefax, Cardiff." (Mr. F. E. Rutter.)

MIDDLESBROUGH OFFICE: Halifax Buildings, Exchange Place.
Telephone: Middlesbrough 3313. Telegrams: "Genefax, Middlesbrough." (Mr. C. Souness.)

★

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"During the 40 years I have been connected with Steel Foundry work, considerable changes have taken place. Away back, we had Steel Moulders' Composition, Old Crucible Pots, etc., and each works claimed to have its own 'secret' moulding composition. High Silica Sand has eliminated practically all these from many foundries and to-day we have your 'Yorkshire Sand' which acts almost like a chill, and leaves the skin of the casting blue-black and as clean as cast iron.

The hot steel lies quietly against the wall of sand, and often when the casting has been lifted out of the mould, the latter looks as if it could be used over again, just like a permanent mould."

RAW MATERIALS—PRICE LIST

(Wednesday, April 21, 1937)

COPPER

	£	s.	d.
Standard cash	60	10	0
Three months	57	7	6
Electrolytic	63	0	0
Tough	67	5	0
Best selected	67	15	0
Sheets	101	0	0
India	78	10	0
Wire bars	69	0	0
Ingot bars	69	0	0
H.C. wire rods	72	10	0
Off. av. cash, Mar.	72	8	11½
Do., 3 mths., Mar.	71	1	5½
Do., Sttlmnt., Mar.	72	7	11½
Do., Electro, Mar.	77	18	6½
Do., B.S., Mar.	77	5	3½
Do., wire bars, Mar.	77	18	6½
Solid drawn tubes			14½d.
Brazed tubes			14½d.
Wire			10½d.

BRASS

Solid drawn tubes	13d.
Brazed tubes	15d.
Rods, drawn	11½d.
Rods, extd. or rlld.	8½d.
Sheets to 10 w.g.	10½d.
Wire	10½d.
Rolled metal	10½d.
Yellow metal rods	8d.

TIN

	£	s.	d.
Standard cash	261	0	0
Three months	256	15	0
English	261	10	0
Bars	263	10	0
Straits	262	5	0
Australian		—	
Eastern	267	10	0
Banca (nom.)	262	10	0
Off. av. cash, Mar.	283	5	7½
Do., 3 mths., Mar.	278	19	6½
Do., Sttlmt., Mar.	283	4	0½

SPELTER

	£	s.	d.
Ordinary	23	13	9
Remelted	23	0	0
Hard	21	0	0
Electro 99.9	26	3	9
English	24	12	6
India	22	0	0
Zinc dust	27	0	0
Zinc ashes	10	0	0
Off. aver., Mar.	33	5	11 1/4
Aver. spot, Mar.	33	3	9

LEAD

	£	s.	d.
Soft foreign, ppt.	24	11	3
Empire (nom.)	23	15	0
English	26	10	0
Off. aver., Mar.	33	0	0½
Aver. spot, Mar.	33	0	6½

ALUMINIUM

Ingots	£100 to £105
Wire	1/3 to 1/4 lb.
Sheet and foil	1/2 to 1/4 lb.

ZINC SHEETS, &c.

Zinc sheets, English	34	10	0	to 35	0	0
Do., V.M. ex-whse.	34	10	0	to 35	0	0
Rods				38	0	0

ANTIMONY

English	88	0	0	to 89	0	0
Chinese, ex-whse.				74	0	0
Crude, c.i.f.				41	0	0

QUICKSILVER

Quicksilver	14	7	3

FERRO-ALLOYS AND STEEL-MAKING METALS

Ferro-silicon—						
25%	12	0	0	(nom.)		
45/50%	10	15	0	to 12	0	0
75%	15	15	0	to 17	0	0
Ferro-vanadium—						
35/50%				12/8 lb. Va		
Ferro-molybdenum—						
70/75% carbon-free				4/9 lb. Mo.		
Ferro-titanium—						
20/25% carbon-free				9d. lb.		
Ferro-phosphorus, 20/25%				£21 to £22		
Ferro-tungsten—						
80/85%				5/- lb. (nom.)		
Tungsten metal powder—						
98/99%				5/3 lb. (nom.)		
Ferro-chrome—						
2/4% car.				31	17	0
4/6% car.				21	10	0
6/8% car.				21	0	0
8/10% car.				21	0	0
Ferro-chrome—						
Max. 2% car.				32	10	0
Max. 1% car.				35	15	0
Max. 0.5% car.				36	10	0
70% carbon-free				9½d. lb.		
Nickel—99.5/100%				£180 to £185		
"F" nickel shot				£165	0	0
Ferro-cobalt, 98/99%				7/3 lb.		
Metallic chromium—						
96/98%				2/5 lb.		
Ferro-manganese—						
76/80% loose	£13	15	0	to 14	5	0
76/80% packed	£14	15	0	to 15	5	0
76/80% export				£13	0	0
Metallic manganese—						
94/96% carbon-free				1/3 lb.		

Per ton unless otherwise stated, basis 2-ton lots.

HIGH-SPEED TOOL STEEL

Finished bars, 14% tungsten	2s. 2d.
Finished bars, 18% tungsten	3s. 0d.

Per lb. net, d/d buyers' works.

Extras—	
Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to 7/16 in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅛ in.	3d. lb.
Do., under ½ in. × ¼ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP

	£	s.	d.	£	s.	d.
South Wales—						
Heavy steel	3	8	0 to	3	10	0
Mixed iron and steel	3	5	0 to	3	7	6
Heavy cast iron	3	7	6 to	3	10	0
Good machinery	4	0	0 to	4	5	0
Cleveland—						
Heavy steel				3	7	0
Steel turnings				2	12	6
Heavy cast iron				4	2	6
Heavy machinery				4	5	0
Midlands—						
Short heavy steel	3	12	6 to	3	15	0
Light cast-iron scrap	3	5	0 to	3	7	6
Heavy wrought iron	3	17	6 to	4	2	6
Steel turnings	2	2	6 to	2	5	0
Scotland—						
Heavy steel	3	4	6 to	3	7	0
Ordinary cast iron				4	5	0
Cast-iron borings	2	0	0 to	2	2	6
Wrot-iron piling				4	5	0
Heavy machinery				4	10	0

London—Merchants' buying prices, delivered yard.

Copper (clean)	46	0	0
Brass	27	0	0
Lead (less usual draft)	19	10	0
Tea lead	15	0	0
Zinc	12	0	0
New aluminium cuttings	74	0	0
Braziery copper	40	0	0
Gunmetal	46	0	0
Hollow pewter	162	0	0
Shaped black pewter	118	0	0

PIG-IRON

N.E. Coast (d/d Tees-side area)—	
Foundry No. 1	83/6
,, No. 3	81/-
,, No. 4	80/-
Forge No. 4	80/-
Hematite No. 1	98/-*
Hematite M/Nos.	97/6*
N.W. Coast—	
Hem. M/Nos. d/d Glas.	98/-*
,, d/d Birm.	109/6*
Malleable iron d/d Birm.	135/-
Midlands (d/d Birmingham dist.)—	
Staffs No. 4 forge	83/-
,, No. 3 fdry.	86/-
Northants forge	80/6
,, fdry. No. 3	83/6
,, fdry. No. 1	86/6
Derbyshire forge	83/-
,, fdry. No. 3	86/-
,, fdry. No. 1	89/-
Scotland—	
Foundry, No. 1, f.o.t.	90/6
,, No. 3, f.o.t.	88/-
Cleveland No. 3, Glasgow	87/-
,, ,, Falkirk	84/-
Scottish hem. M/Nos. d/d	98/-*
Sheffield (d/d district)—	
Derby forge	80/6
,, fdry. No. 3	83/6
Lincs forge	80/6
,, fdry. No. 3	83/6
W.C. hematite	103/6*
Lancashire (d/d eq. Man.)—	
Derby fdry. No. 3	89/-
Staffs fdry. No. 3	89/-
Northants fdry. No. 3	87/6
Cleveland fdry. No. 3	89/-
Glengarnock, No. 3	106/-
Clyde, No. 3	106/-
Monkland, No. 3	106/-
Summerlee, No. 3	106/-
Eglinton, No. 3	106/-
Gartsherrie, No. 3	106/-
Shotts, No. 3	106/-

* Subject to a rebate of 5s. per ton under certain conditions.

FINISHED IRON AND STEEL

Usual district deliveries for iron; delivered consumer's station for steel.

	£	s.	d.	£	s.	d.
Iron—						
Bars (cr.)				11	17	6
Nut and bolt iron	10	5	0 to	10	15	0
Hoops				12	15	0
Marked bars (Staffs) f.o.t.				14	7	6
Gas strip				12	15	0
Bolts and nuts, ¾ in. × 4 in.				17	10	0 and up.
Steel—						
Plates, ship, etc.	9	10	6 to	9	13	0
Boiler plts	10	0	6 to	10	3	0
Chequer plts.				11	3	0
Angles				9	3	0
Tees				10	3	0
Joists				9	3	0
Rounds and squares, 3 in. to 5½ in.				10	3	0
Rounds under 3 in. to ⅛ in. (Untested)				9	10	0
Flats—8 in. wide and over				9	8	0
,, under 8 in. and over 5 in.				9	13	0
Rails, heavy	8	5	0 to	8	10	0
Fishplates				12	10	0
Hoops (Staffs)				10	5	0
Black sheets, 24g. (4-t. lots)				14	0	0
Galv. cor. shts. (,,)				17	0	0
Galv. flat shts. (,,)				17	10	0
Galv. fencing wire, 8g. plain				16	0	0
Billets, soft				6	5	0
Sheet bars			6 2	6 and up.		
Tin bars			6 2	6 and up.		

PHOSPHOR BRONZE

	Per lb. basis
Strip	14d.
Sheet to 10 w.g.	15d.
Wire	15½d.
Rods	16d.
Tubes	21d.
Castings	16d.

Delivery 3 cwt. free.
10% phos. cop. £33 above B.S.
15% phos. cop £38 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	10d. to 1/4
Rolled—	
To 9 in. wide	1/4 to 1/10
To 12 in. wide	1/4½ to 1/10½
To 15 in. wide	1/4½ to 1/10½
To 18 in. wide	1/5 to 1/11
To 21 in. wide	1/5½ to 1/11½
To 25 in. wide	1/6 to 2/-
Ingots for spoons and forks	10d. to 1/6½
Ingots rolled to spoon size	1/1 to 1/9½
Wire round—	
to 10g.	1/7½ to 2/2½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/6½ upwards.

AMERICAN IRON AND STEEL

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	25.76
No. 2 foundry, Valley	24.00
No. 2 foundry, Birm.	20.38
Basic, Valley	23.50
Malleable, Valley	24.00
Grey forge, Valley	20.50
Ferro-mang. 80%, seaboard	95.00
O.-h. rails, h'y, at mill	42.50
Billets	37.00
Sheet bars	37.00
Wire rods	47.00
	Cents.
Iron bars, Chicago	2.40
Steel bars	2.45
Tank plates	2.25
Beams, etc.	2.15
Skelp, grooved steel	2.10
Steel hoops	2.10
Sheets, black, No. 24	2.40
Sheets, galv., No. 24	3.80
Wire nails	2.75
Plain wire	2.90
Barbed wire, galv.	3.40
Tinplates, 100-lb box	$4.85

COKE (at ovens)

Welsh foundry	32/6 to 33/-
,, furnace	27/- to 28/-
Durham foundry	31/6
,, furnace	30/6
Scotland foundry	—
,, furnace	28/-

TINPLATES

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 per box	24/- to 25/-
,,	28×20 ,,	48/- to 50/-
,,	20×10 ,,	34/6 to 35/6
,,	18⅞×14 ,,	25/- to 25/9
C.W.	20×14 ,,	22/- to 22/9
,,	28×20 ,,	44/- to 45/6
,,	20×10 ,,	30/- to 32/-
,,	18⅞×14 ,,	23/- to 24/-

SWEDISH CHARCOAL IRON & STEEL

Pig-iron	£12	0	0 to	£13	0	0
Bars-hammered, basis	£19	0	0 to	£20	0	0
Bars and nail-rods, rolled, basis	£19	0	0 to	£20	0	0
Blooms	£14	0	0 to	£14	10	0
Keg steel	£26	0	0 to	£29	0	0
Faggot steel	£19	0	0 to	£25	0	0

Bars and rods dead soft, st'. £16 0 0 to £18 0 0
All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 19.39 to £1.]

DAILY FLUCTUATIONS

Standard Copper (cash)

		£	s.	d.	
Apr.	15 ..	64	2	6	No change
,,	16 ..	62	0	0	dec. 42/6
,,	19 ..	59	5	0	,, 55/-
,,	20 ..	55	10	0	,, 75/-
,,	21 ..	60	10	0	inc. 100/-

Electrolytic Copper

		£	s.	d.	
Apr.	15	68	10	0	No change
,,	16 ..	67	0	0	dec. 30/-
,,	19	65	0	0	,, 40/-
,,	20 ..	62	0	0	,, 60/-
,,	21 ..	63	0	0	inc. 20/-

Standard Tin (cash)

		£	s.	d.		
Apr.	15 ..	272	10	0	dec.	65/-
,,	16 ..	265	10	0	,,	140/-
,,	19 ..	258	0	0	,,	150/-
,,	20 ..	249	0	0	,,	180/-
,,	21 ..	261	0	0	inc.	240/-

Tin (English ingots)

		£	s.	d.		
Apr.	15 ..	272	10	0	dec.	65/-
,,	16 ..	265	10	0	,,	140/-
,,	19 ..	258	0	0	,,	150/-
,,	20 ..	249	10	0	,,	170/-
,,	21 ..	261	10	0	inc.	240/-

Spelter (ordinary)

		£	s.	d.		
Apr.	15 ..	26	6	3	inc.	3/9
,,	16 ..	26	0	0	dec.	6/3
,,	19 ..	24	12	6	,,	27/6
,,	20 ..	22	7	6	,,	45/-
,,	21 ..	23	13	9	inc.	26/3

Spelter (Electro, 99.9 per cent.)

		£	s.	d.		
Apr.	15 ..	28	18	9	inc.	3/9
,,	16 ..	28	10	0	dec.	8/9
,,	19 ..	27	2	6	,,	27/6
,,	20 ..	24	17	6	,,	45/-
,,	21 ..	26	3	9	inc.	26/3

Lead (soft foreign, prompt)

		£	s.	d.		
Apr.	15 ..	25	7	6	dec.	6/3
,,	16 ..	25	1	3	,,	6/3
,,	19 ..	24	1	3	,,	20/-
,,	20 ..	23	0	0	,,	21/3
,,	21 ..	24	11	3	inc.	31/3

Lead (English)

		£	s.	d.		
Apr.	15 ..	27	10	0	No	change
,,	16 ..	27	0	0	dec.	10/-
,,	19 ..	26	0	0	,,	20/-
,,	20 ..	25	0	0	,,	20/-
,,	21 ..	26	10	0	inc.	30/-

Imports and Exports of Pig-iron, Castings, etc., in March and the Three Months 1937, compared with March and the Three Months 1936.

	March.		Three months.		March.		Three months.	
	1936.	1937.	1936.	1937.	1936.	1937.	1936.	1937.
	Tons.	Tons.	Tons.	Tons.	£	£	£	£
Imports.								
Pig-iron—from Brititish India	6,262	18,989	18,069	44,541	19,666	64,126	55,886	148,368
,, ,, Other British Countries	—	—	—	5,070	—	—	—	21,167
,, ,, Foreign Countries	1,339	2,294	5,950	7,100	8,011	14,458	33,086	44,197
Total	7,601	21,283	24,019	56,711	27,677	78,584	88,972	213,732
Castings and forgings	920	178	2,200	752	30,205	6,258	71,315	20,476
Cast pipes and fittings	76	78	309	307	3,973	2,271	10,572	7,846
Stoves, grates, etc.	51	47	152	186	6,382	6,834	19,598	19,220
Baths	404	1,039	1,903	2,284	10,727	24,574	47,975	53,927
Hollow-ware, all kinds	211	269	794	798	11,692	16,495	43,641	48,393
Exports.								
Pig-iron, forge and foundry	4,309	12,030	12,794	26,317	15,306	56,712	47,124	122,233
,, acid	2,342	4,234	7,254	15,426	8,269	23,461	24,619	74,419
,, basic	22	110	50	391	72	922	184	2,407
Total	6,673	16,374	20,098	42,134	23,647	81,095	71,927	199,059
Castings and forgings	494	217	1,178	884	15,615	7,706	41,534	31,778
Cast pipes and fittings, up to 6 in. diameter	4,405	5,548	12,728	13,585	49,989	57,080	146,023	145,519
,, ,, over 6 in. ,,	3,845	3,025	11,776	8,293	28,340	22,840	95,304	65,817
Stoves, grates, etc.	800	1,093	2,720	2,963	44,321	59,411	136,563	159,434
Sanitary cisterns	241	343	750	901	8,177	10,620	24,255	28,172
Bedsteads, including tubes, therefor	409	497	1,261	1,344	15,495	19,930	46,647	51,189
Cast hollow-ware	443	441	1,297	1,323	17,127	15,791	46,534	45,518

WILLIAM JACKS & COMPANY,
WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.
CLARENCE CHAMBERS, 39, CORPORATION STREET, BIRMINGHAM.
13, RUMFORD STREET, LIVERPOOL.
PIG IRON
REGISTERED TRADE MARK
All grades FOUNDRY, HEMATITE, BASIC, SPECIALS, &c.
NON-FERROUS METALS
COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.
WILLIAM JACKS & COMPANY,
CENTRAL CHAMBERS, 93, HOPE ST., GLASGOW, C.2.
ZETLAND ROAD, MIDDLESBROUGH.

Notice

Small Advertisements in this section of the Journal are accepted at the prepaid rate of 6d. per line, first line in capitals counting two, average 6 words per line. Minimum charge for one insertion 3/-

(A remittance should accompany instructions.)

SITUATIONS VACANT AND WANTED

FOREMAN required to take charge of small iron foundry in South of England. Must be thoroughly experienced moulder and furnace man. State full experience and wages required.—Box 344, Offices of The Foundry Trade Journal, 49, Wellington Street, Strand, London, W.C.2.

FOUNDRY Foreman for Stove Grate Works in the Midlands. Expert in machine moulding, plate work and cupola. Apply stating salary required, and full details of experience, to Box 350, Offices of The Foundry Trade Journal, 49, Wellington Street, Strand, London, W.C.2.

WANTED.—Foreman to take charge of foundry extension, specialising in ingot moulds, in North of England. State full experience, age, and salary required.—Box 342, Offices of The Foundry Trade Journal, 49, Wellington Street, Strand, London, W.C.2.

WANTED.—Experienced Moulder for small aluminium foundry in London; to take charge as Working Foreman. Write in confidence.—Box 336, Offices of The Foundry Trade Journal, 49, Wellington Street, Strand, London, W.C.2.

EMPLOYMENT REGISTER.

Conducted by the Institute of British Foundrymen by courtesy of the proprietors of The Foundry Trade Journal.

Correspondence should be addressed to the General Secretary, Institute of British Foundrymen, St. John Street Chambers, Deansgate, Manchester, from whom full particulars can be obtained of this service.

Any employer wishing to communicate with a candidate should write to the General Secretary, quoting identification number.

IRON and Steel Works Metallurgist desires change. Thorough experience all branches; analytical, metallurgical, heat-treatment, testing, pyrometry, etc. Practical steelmaking and rolling experience. (297)

FOUNDRY Foreman requires position. Excellent experience with high-class work, including repetition work and moulding machines. Metal mixing. Accustomed to modern foundry plant, estimating and costing. (299)

PATENT

THE Proprietor of the Patent No. 407,472, for Improved Method of and Means for Producing Hollow Billets for Hollow Drills and the like, is desirous of entering into arrangements by way of licence and otherwise on reasonable terms for the purpose of exploiting the same and ensuring its full development and practical working in this country. All communications should be addressed in the first instance to: Haseltine Lake & Co., 28, Southampton Buildings, Chancery Lane, London, W.C.2.

MACHINERY

FOR SALE.—No. 12 "Ajax" Jolt, Turnover, Pattern Draw Moulding Machine; capacity 28 cwts.; table 54 in. by 56 in.; pattern draw 15 in. Guaranteed condition.—Reply to: Box 346, Offices of The Foundry Trade Journal, 49, Wellington Street, Strand, London, W.C.2.

MACHINERY—*Continued*

LADLES FOR SALE.—I have most sizes of Crane Ladles in stock from 20 lbs. capacity up to 18 tons. Inquiries for any particular size solicited.—A. Hammond, 14, Australia Road, Slough.

ONE No. 601 Osborn-type Rollover Jolt Rammer, 30 in. long, cap. 600 lbs., complete with vibrator and blow-off cock. Two No. 2 Roots Blowers by Samuelson. One Type D Air Compressor by Broom & Wade. One Wheel Moulding Machine by Whittaker (Oldham). One Core Oven by Horace Marshall. —Box 348, Offices of The Foundry Trade Journal, 49, Wellington Street, Strand, London, W.C.2.

SAND MIXERS AND AERATORS.—The "Breakir" Centrifugal Machine is *THE* machine. Outputs 10 cwts. to 8 tons per hr.—W. Brealey & Co., Ltd., Station Works, Ecclesfield, Sheffield.

NEW Dwarf Cupola, to melt 10 to 15 cwts. per hr. New Worm-geared Ladles, 5 tons, 25 cwts., 15 cwts. and 10 cwts. capacity. Ungeared Ladles, 15 cwts. and 10 cwts. capacity. Improved Cupola Spark Arresters.—T. Davies & Son, West Gorton, Manchester.

Phone **98** Staines.

VERTICAL Boiler, 8 ft. 8 in. by 4 ft., 80 lbs. w.p.
8-in. Roots Blower, as new, 5 lbs. pressure.
Horizontal Compressor, steam driven, 8 in. and 8½ in. by 9 in.
Air Receiver, 11 ft. 6 in. by 2 ft. 6 in
Air Receiver, 20 ft. by 3 ft.
HARRY H. GARDAM & CO., LTD., STAINES.

ELECTRIC CUPOLA BLOWERS (large stock), including two 50-h.p. 3/50/400 volts, 2,900 r.p.m.; Keith Blackman; 12-in. outlet.
30-h.p. ditto; 12-in. outlet.
5-h.p. ditto; 6-in. outlet.
20-h.p. 460 volts d.c., 2,400/1,900 r.p.m.; 10-in. outlet.
EXHAUST FANS (large stock), electrical and belt driven.
ELECTRIC RUNWAY LIFTING BLOCKS:
One 4½-ton 460 volts d.c., Vaughan.
Two 2-ton ditto, Morris.
One ½-ton 220 volts d.c., Morris (as new).
One ½-ton 3/50/440 volts, Aabacas.
Two Reavell Rotary Compressors, 12 lbs. sq. in. pressure: 750 cub. ft. direct-coupled on bedplate to 60 h.p. S.R., 3/50/400 volts motor.
½-cwt. Pilkington Self-contained Pneumatic Hammer.
Geared Foundry Ladles, 9, 4, 3½, 2½ and 1 ton, etc.
AIR COMPRESSORS: 30 in stock in sizes 500 to 20 cub. ft.
ELECTRIC MOTORS: Large stock to suit almost all electric systems.
S. C. BILSBY, A.M.I.C.E., A.M.I.E.E.
CROSSWELLS ROAD (Adjoining Railway Crossing), LANGLEY, Nr. Birmingham.
'Phone: Broadwell 1359.

THOS. W. WARD LTD.
FOR ECONOMY — EFFICIENCY — GENERAL UTILITY.
"FORWARD" FOUNDRY SAND RIDDLE.
Capacity approximately 5 tons of foundry sand per hr. Self-contained. Drive from ¼ h.p., totally-enclosed motor. All working parts fitted ball bearings; provided with dust guards. 22" dia. sieve can be removed and replaced instantly. Tubular tripod with shoes. Price, with a.c. or d.c. motor, standard voltage, £25 10s.
Write for "Albion" Catalogue.
'Grams: "Forward." 'Phone: 23001 (10 lines).
ALBION WORKS, SHEFFIELD.

MISCELLANEOUS

WANTED.—One reconditioned Oil-fired Annealing Oven. Size of combustion chamber, 6 ft. long by 3 ft. wide, 3 ft. height to eaves, 3 ft. 6 in. height to crown. Oven to be fitted with one bogie to run on loose ball vee track.—Box 352, Offices of The Foundry Trade Journal, 49, Wellington Street, Strand, London, W.C.2.

GENUINE Southport Wind Blown Sand, which makes best oil-sand cores. Prompt deliveries by road into works.
JOHN LIVESEY,
Sand Merchant,
SOUTHPORT.

STRAW ROPES for core and packing purposes. Sizes ¼ in. to 1¾ in. dia. We quote by weight as well as by measure. Important—We are the only local makers of this article.—William Olsen, Ltd., Hull.

FINEST FOUNDRY BLACKINGS AND FACINGS. All our own productions by the latest machinery. Pure Ceylon Plumbago (import direct). Quality at reasonable prices. Orders are repeated Send for free sample.
JOHN & C. DURRANS,
PENNINE WORKS,
HAZLEHEAD, NEAR SHEFFIELD.
Telephone: 128 Penistone. Telegrams: "Facings, Penistone."

'Phone: 287 SLOUGH

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